USAAEFA PROJECT NO. 80-06

PRELIMINARY AIRWORTHINESS EVALUATION OF THE UH-1H WITH HOT METAL PLUS PLUME INFRARED SUPPRESSOR AND INFRARED JAMMER

FINAL REPORT

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The Preliminary Airworthiness Evaluation (PAE) of the UH-1H, with the ~~Garrett AiResearch~~ Infarared (IR) Suppressor and AN/ALQ-144 IR Jammer installed, was conducted at Edwards Air Force Base, California, (elevation 2300 feet) and Bakersfield, California, (elevation 490 feet) using a JUH-1H helicopter (S/N 69-15532). A total of 20.7 hours were flown during this test program. This PAE was an evaluation of a redesigned IR suppressor and IR jammer installation for the UH-1H helicopter. The initial design was [illegible] by Bell Helicopter Textron (BHT) [illegible] caused a degradation in directional stability. The installation was redesigned to reduce the airflow disturbance over the tail rotor and vertical stabilizer. This evaluation was conducted in two phases. Phase I (16 January through 6 February 1981; 9.5 flight hours) was a comparative evaluation of handling qualities of the UH-1H in

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both the standard and IR suppressor configurations. Phase II (29 April through 18 May 1981; 11.2 flight hours) was primarily a pressure and temperature survey of the IR suppressor configuration. The handling qualities of the UH-1H helicopter were essentially unchanged by the IR suppressor and IR jammer installation tested. The previously reported degradation in directional stability was not observed during this test. The tail boom surface temperatures were generally higher than those reported by BHT for the initial design and the structural implications of these higher temperatures should be investigated. One deficiency, the metal to metal contact between the engine exhaust ejector and the IR suppressor inner core support struts, was identified. Three shortcomings were also identified.

DEPARTMENT OF THE ARMY
HQ, US ARMY AVIATION RESEARCH AND DEVELOPMENT COMMAND
4300 GOODFELLOW BOULEVARD, ST. LOUIS, MO 63120

DRDAV-D

SUBJECT: USAAEFA Report, Preliminary Airworthiness Evaluation of the UH-1H with Hot Metal Plus Plume Infrared Suppressor and Infrared Jammer, USAAEFA Project No. 80-06

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1. The purpose of this letter is to establish the Directorate for Development and Qualification position on subject report. The report documents the test results of the subject evaluation and substantiates that the handling qualities of the JUH-1H with the Hot Metal Plus Plume Suppressor are essentially the same as those of the standard UH-1H helicopter. The tail boom surface temperatures were generally higher than those reported by Bell Helicopter Textron for the initial design.

2. This Directorate agrees with the report's conclusions and recommendations. Additional design development is in progress by BHT under Army contract and further flight testing will be conducted which should accommodate the recommendations and conclusions of this report.

FOR THE COMMANDER:

CHARLES C. CRAWFORD, JR.
Director of Development
and Qualification

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

APPENDIXES

INTRODUCTION

BACKGROUND

1. The United States Army requires a reduced infrared (IR) signature and increased protection from IR seeking weapons for its aircraft. To achieve these goals, the US Army contracted with Bell Helicopter Textron (BHT) to develop an installation to accommodate a Garrett AiResearch Manufacturing Company (Garrett) hot metal plus plume (HMPP) IR suppressor and an AN/ALQ-144 IR jammer on the UH-1H helicopter. BHT was required to prove feasibility of the HMPP IR suppressor design, conduct limited flight testing, and assess IR cooling. Flight testing of the initial design by BHT showed that the suppressor pressures and the suppressor and tail boom temperatures were acceptable; however, the directional stability characteristics of the aircraft were degraded. BHT initiated a redesign of the suppressor and jammer installation to reduce the airflow disturbance, which was believed to be causing the degradation of directional stability. The US Army Aviation Research and Development Command (AVRADCOM) directed the US Army Aviation Engineering Flight Activity (USAAEFA) to perform a preliminary airworthiness evaluation (PAE) of the UH-1H with the redesigned IR suppressor and jammer installation (ref 1, app A). A test plan (ref 2) was submitted in January 1981 and an Airworthiness Release (ref 3) was issued in February 1981.

TEST OBJECTIVES

2. The overall objectives of this PAE were to determine if the redesigned suppressor and jammer installation changed the handling qualities of the UH-1H and to conduct a survey of suppressor pressures and suppressor and tail boom temperatures.

3. The specific test objectives were:

a. To provide quantitative and qualitative flight test data of the aircraft handling qualities.

b. To determine suppressor pressures and suppressor and tailboom temperatures.

DESCRIPTION

4. The UH-1H is a thirteen-place single engine helicopter using a single two-blade teetering main rotor and pusher tail rotor. The maximum gross weight of the helicopter is 9500 pounds. Power is provided by a Lycoming T53-L-13 free turbine engine rated at 1400 shaft horsepower (SHP). However, the helicopter is limited by the transmission to 1100 SHP. A more complete description may be found in the detail specification (ref 5, app A) and the operator's manual (ref 4). The test helicopter was a JUH-1H, S/N 69-15532. The significant external differences from the standard UH-1H were removal of the cargo hook and the addition of an airspeed boom, 9.5 feet long, mounted on the centerline of the helicopter at the base of the windshield center post. Internal differences consisted primarily of the instrumentation system. These differences had no significant effect on the flight test results.

5. The IR suppressor and jammer installation consisted of a Garrett HMPP IR suppressor, originally developed for the AH-1S helicopter, an AN/ALQ-144 IR jammer, and a redesigned aft engine cowl to support the suppressor and jammer. A more detailed description of the IR suppressor and jammer installation is provided in appendix B.

TEST SCOPE

6. Flight testing was conducted at Edwards Air Force Base, California, (elevation 2302 feet) and Bakersfield, California, (elevation 490 feet) during the period 16 January 1981 through 18 May 1981. A total of 16 flights were conducted during which 20.7 hours were flown. Tests were conducted in two phases. The first phase consisted of an evaluation of handling characteristics with primary emphasis on the lateral-directional stability characteristics of the aircraft with the IR suppressor and jammer installed. Data were also taken with the aircraft in the standard configuration as a basis for comparison. The second phase tests were primarily a survey of IR suppressor pressures and suppressor and tailboom temperatures. Flight restrictions and operating limitations contained in the airworthiness release (ref 3, app A), and the operator's manual (ref 4) were observed. Where possible, flight test data were compared with the applicable specifications (refs 5 and 6) and with data obtained from previous tests of the UH-1H (refs 7, 8, and 9). Flight tests were conducted under the conditions specified in table 1.

TEST METHODOLOGY

7. Established flight test techniques were used throughout this evaluation (ref 10, app A). Test methods used are briefly discussed in the Results and Discussion section of this report. The handling qualities rating scale (HQRS) shown in figure 1, appendix D, was used to supplement pilot comments on handling qualities. All flight test data, during the handling qualities tests, were obtained from calibrated test instrumentation and were recorded on magnetic tape. Data obtained during the pressure/temperature survey were recorded both on magnetic tape (pressures) and by hand from cockpit instrumentation (temperatures). A detailed listing of the test instrumentation is contained in appendix C. The definitions of deficiencies and shortcomings used during this test and data analysis methods used are presented in appendix D.

Table 1. Test Conditions

Test	Gross Weight (lb)	Longitudinal Center of Gravity Location (FS)	Density Altitude (FT)	True Calibrated Airspeed (KT)	Remarks
HANDLING QUALITIES (IR Suppressor Configuration)					
Control positions in trimmed forward flight	8760	137.4 (FWD)	5140	43 to 107	Level flight
	8880	[illegible] (FWD)	[illegible]	66 and [illegible]	Climb and Descent
	8840	141.2 (AFT)	[illegible]	[illegible] to 108	Level flight
	8540	140.9 (AFT)	[illegible]	[illegible] to 9[illegible]	Climb and Descent
Static longitudinal stability	8980	142.2 (AFT)	[illegible]	68 and 95	Level flight
	8840	[illegible] (AFT)	5140	65 and 93	Climb and Descent
Static lateral-directional stability	[illegible]	[illegible] (AFT)	2203	66 and 107	Level flight
	[illegible]	[illegible]	[illegible]	[illegible]	Climb and Descent
Maneuvering stability	[illegible]	[illegible] (AFT)	[illegible]	[illegible]	Level flight trim
Dynamic stability	8840	[illegible] (AFT)	[illegible]	[illegible] and 93	Level flight
				65 and 90	Climb
				[illegible]	Autorotation
Low speed flight characteristics[1]	[illegible]	[illegible] (FWD)	[illegible]	35	Left and Right
				[illegible]	Rearward
				[illegible]	Forward
	[illegible]	[illegible] (AFT)	[illegible]	[illegible]	Left and Right
				30	Rearward
				[illegible]	Forward
Maneuvering characteristics in IMC[2]	[illegible]	[illegible]	[illegible]		[illegible] IMC[2] [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Level flight trim
HANDLING QUALITIES ([illegible])					
Control positions in trimmed forward flight	[illegible]	[illegible] (AFT)	[illegible]	[illegible]	Level flight
	[illegible]	[illegible]		[illegible]	Climb and Descent
Static longitudinal stability	[illegible]	142.0 (AFT)	[illegible]	[illegible]	Level flight trim
Static lateral-directional stability	[illegible]	[illegible] (AFT)	[illegible]	[illegible]	Level flight trim
Maneuvering stability	[illegible]	[illegible] (AFT)	[illegible]	[illegible]	Level flight trim
Simulated engine failures	[illegible]	[illegible] (AFT)	[illegible]	[illegible] and 94	Level flight trim
Dynamic stability	[illegible]	[illegible] (AFT)	[illegible]	[illegible]	Level flight Climb
PRESSURE-TEMPERATURE SURVEY (IR Suppressor Configuration)					
IGE Hover[3]	[illegible]	[illegible] (FWD)	[illegible]	Zero	
OGE Hover[4]	[illegible]	[illegible] (FWD)	[illegible]	Zero	
Low speed flight[1]	[illegible]	[illegible] (FWD)	[illegible]	30	Left and Right
				[illegible]	Rearward
				[illegible]	Forward
Acceleration/Deceleration	[illegible]	[illegible] (FWD)	[illegible]	0 to 40	Pressure survey only
Climbs	[illegible]	[illegible] (FWD)	[illegible]	[illegible]	[illegible]
Level flight	[illegible]	[illegible] (FWD)	[illegible]	64 to [illegible]	
Level flight in sideslips	[illegible]	[illegible] (FWD)	[illegible]	[illegible]	0 to [illegible] degrees Left and Right
Simulated engine failures	[illegible]	[illegible] (FWD)	[illegible]	[illegible]	Pressure survey only
Autorotation	[illegible]	[illegible] (FWD)	[illegible]	[illegible]	Pressure survey only

NOTES

[1] Airspeeds listed are true rather than calibrated
[2] Instrument Meteorological Conditions (IMC)
[3] In Ground Effect (IGE) Hover
[4] Out of Ground Effect (OGE) Hover

RESULTS AND DISCUSSION

GENERAL

8. This PAE was an evaluation of a redesigned IR suppressor and IR jammer installation for the UH-1H helicopter. The initial design was reported by BHT (ref 9, app A) to have caused a degradation in directional stability. The installation was redesigned to reduce the airflow disturbance over the vertical stabilizer. This evaluation was conducted in two phases. Phase I was a comparative evaluation of handling qualities of the UH-1H in both the standard and IR suppressor configurations. Phase II was primarily a pressure and temperature survey of the IR suppressor configuration. The handling qualities of the UH-1H helicopter were essentially unchanged by the IR suppressor and IR jammer installation tested. The previously reported degradation in directional stability was not observed during this test. The tail boom surface temperatures were generally higher than those reported by BHT for the initial design and the structural implications of these higher temperatures should be investigated. One deficiency, the metal to metal contact between the engine exhaust ejector and the IR suppressor innercore support struts, was identified. No new specification non-compliances were identified as a result of the IR suppressor installation on the UH-1H helicopter. Three shortcomings were identified.

HANDLING QUALITIES

General

9. The handling qualities of the UH-1H were evaluated at the test conditions listed in table 1. All tests were conducted using standard flight test techniques (ref 10, app A). Tests were conducted with the IR suppressor and IR jammer installed and repeated with the standard UH-1H tailpipe installed. Data obtained from these tests were compared to determine if the handling characteristics of the UH-1H were significantly affected by the installation of the IR suppressor system. Additionally, data were compared with previous tests of a standard UH-1H (refs 7 and 8) and a previous design of the IR suppressor installation (ref 9). Test results show that the handling qualities of the UH-1H are essentially unchanged by the installation of the HMPP IR suppressor and AN/ALQ-144 jammer.

Control Positions in Trimmed Forward Flight

10. The control positions were evaluated in level flight and in climbs and descents. Test results are presented in figures 1 through 6, appendix E. The control positions in trimmed forward flight were essentially unchanged from the standard UH-1H.

Static Longitudinal Stability

11. Tests were conducted in level flight for both the standard and the IR suppressor configurations. Climbs were conducted at intermediate rated power (IRP) and descents were conducted at approximately 10 pounds per square inch (psi) indicated engine torque, in the IR suppressor configuration only. Data are presented in figures 7 through 10, appendix E. The aircraft exhibited positive longitudinal control force and position stability for all conditions tested. Qualitatively, the stability characteristics observed during climbs and descents were similar to those of the standard UH-1H aircraft. The static longitudinal stability was essentially unchanged by the installation of the IR suppressor assembly.

Static Lateral-Directional Stability

12. The tests were conducted in level flight, climb, and descent. The standard configuration was evaluated in level flight only. Test results are presented in figures 11 through 14, appendix E. The test aircraft exhibited both positive directional stability and positive dihedral effect. A direct comparison between the IR suppressor configuration (fig. 11) and the standard configuration (fig. 12) shows essentially no change in lateral-directional stability characteristics. Stability characteristics during climbs and descents qualitatively were unchanged from standard UH-1H aircraft. The static lateral-directional stability of the UH-1H aircraft was essentially unchanged by the installation of the IR suppressor system.

Maneuvering Stability

13. The maneuvering stability characteristics were evaluated using constant airspeed left and right turns with the collective control fixed at the initial trim position. Flight test data for both the IR suppressor installation and the standard UH-1H are presented in figures 15 and 16, appendix E, respectively. The stick-fixed stability (control position vs load factor) was positive for the load factors tested. Control position gradients were similar for both configurations. Qualitatively there was no change in the stick-free stability (control force vs load factor). The maneuvering stability characteristics were essentially the same as those noted for the standard UH-1H.

Dynamic Stability

14. The longitudinal dynamic stability characteristics were evaluated in level flight. Data are presented in figures 17 through 19, appendix E. Both the short-term and long-term dynamic response was essentially deadbeat and no difference was noted between the IR suppressor and standard tailpipe configurations.

15. The lateral-directional dynamic stability characteristics were evaluated in level flight for both the standard and the IR suppressor configurations. Directional control doublets and pulses were the most effective methods of exciting the lateral-direction oscillation. Data for both configurations are presented in figures 20 through 28, appendix E. A lightly damped roll-yaw oscillation was observed for both configurations tested. The installation of the IR suppressor system had no significant effect on the lateral-directional characteristics of the standard UH-1H helicopter.

Low-Speed Flight Characteristics

General

16. Testing was accomplished using the ground pace vehicle method at a constant skid height of 10 feet in winds of 5 knots or less. Data were recorded at 5 knot increments from a hover to 40 knots forward, 30 knots rearward, and 35 knots sideward flight. Control excursions, as presented on the data plots, give an indication of pilot work load and were supplemented by pilot qualitative comments. The results of these tests were compared to those previously reported for the standard UH-1H helicopter (refs 7 and 8, app A). The low speed handling qualities of the UH-1H equipped with the IR suppressor and jammer were essentially unchanged from the standard configuration.

Forward and Rearward Flight:

17. The results of the forward and rearward flight tests are presented as figures 29 and 30, appendix E. Figure 30 shows that at rearward airspeeds of 16 to 29 knots true airspeed (KTAS) (forward cg 132.1) less than 10 percent aft longitudinal control margin remained. The aft longitudinal control inputs which were necessary to control the aircraft pitching motion within the 10 to 15 knot range resulted in a higher pilot work load (HQRS 5), as documented in reference 8, appendix A. Depending on pilot seat position, the pilot may contact equipment attached to his survival vest with the cyclic prior to reaching the full aft longitudinal control position. The lack of adequate longitudinal control margin within the specified limit of the operator's manual was previously reported as a deficiency (ref 7) and was not a result of the IR suppressor and jammer installation.

Sideward Flight:

18. The results of the left and right sideward flight tests are presented as figures 31 and 32, appendix E. The longitudinal trim shift of approximately 2.5 inches during left sideward flight between 8 and 15 KTAS is characteristic of the standard UH-1H (ref 8, app A) and contributed to high pilot work load (HQRS 5). Figure 32, shows that at the left sideward flight limit of 35 KTAS the right directional control pedal stop was contacted. Inadequate directional control margin was previously reported as a deficiency for the standard UH-1H (ref 7) and was not a result of the IR suppressor and jammer installation.

Mission Maneuvering Characteristics

19. Confined area operations, pinnacle operations, nap of the earth and contour flight, non-precision and precision instrument approaches were performed in light to moderate turbulence to evaluate aircraft handling characteristics in turbulence. No degredation of handing qualities due to the IR suppressor installation was observed during operation in turbulence. The aircraft response from light to moderate turbulence was essentially unchanged from the standard UH-1H.

Simulated Engine Failures

20. Simulated engine failures were performed in level flight by rapidly rolling the throttle to the flight idle detent. Flight controls were held fixed until activation of the low main rotor speed audio tone. Data are presented in figures 33 through 36, appendix E. Tests showed no degredation of handling qualities due to the IR suppressor installation. The aircraft response to simulated engine failures was essentially unchanged from the standard UH-1H.

Pressure Survey

21. Static and total pressures surrounding the IR suppressor were recorded at the test conditions listed in table 1. The type and location of the pressure sensors are shown in table 1, appendix C. Pressure data is provided in tables 1 and 2, appendix E.

Temperature Survey

22. Temperatures surrounding the IR suppressor and along the tail boom were recorded at the test conditions listed in table 1. The locations of temperature sensitive tapes and thermocouples are shown in table 2, appendix C. All recorded thermocouple and temperature sensitive tape data are presented in tables 3 and 4, appendix E. Generally higher temperatures were observed than those previously reported by BHT (ref 9, app A) for the initial IR suppressor installation. This may be accounted for by the redesign of the IR suppressor installation which resulted in a 5 degree depression of the IR suppressor exhaust centerline. A comparison of maximum tail boom temperatures obtained during this test with those previously reported by BHT is shown in figure 1. An increase of 80° F during hover and 140° F during low speed flight was observed. Further investigation to determine the structural implications of the high tail boom temperatures observed during this test should be conducted prior to release for field operations.

RELIABILITY AND MAINTAINABILITY

General

23. The reliability and maintainability of the IR suppressor and related components of the installation were evaluated during both phases of testing. Phase I testing was performed using an IR suppressor (AiResearch S/N 39-D1) which had a total of 235 flight hours when it arrived at USAAEFA. A new IR suppressor (AiResearch S/N 129-147) was provided for phase II testing. The new IR suppressor incorporated modifications which were designed to prevent cracking around the inner core support struts.

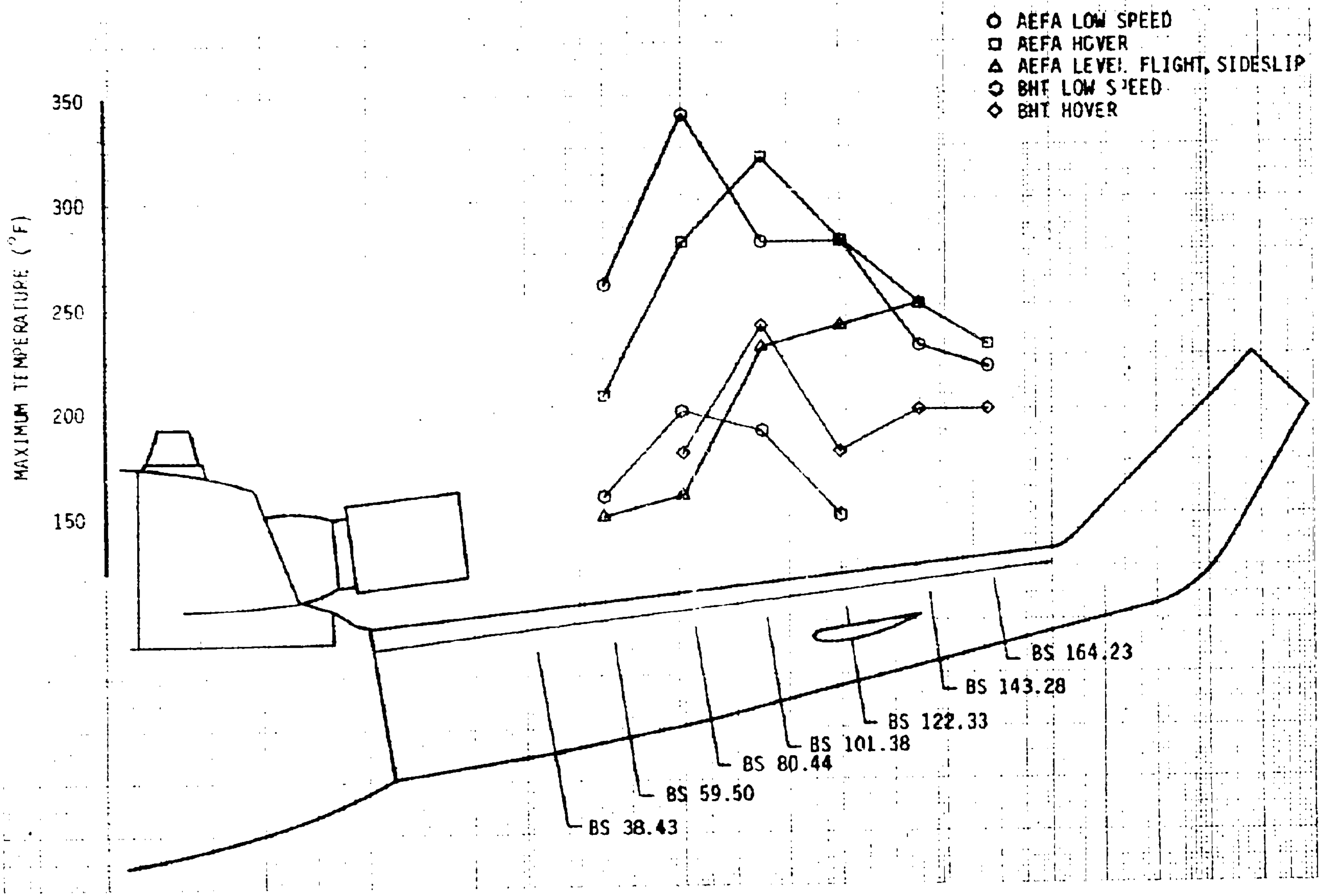
Phase I Testing

24. The IR suppressor was found to be susceptible to cracking around the struts which support the inner core of the suppressor unit. When the unit arrived at USAAEFA, numerous cracks were discovered. It appeared that if flights were conducted without first having the unit repaired, small triangular pieces of metal could be dislodged from the inner core of the unit. The unit was repaired by welding prior to installation. Upon completion of Phase I tests, (9.5 flight hours) cracks were again observed in the area where the repair had been made as well as small cracks at each of the remaining struts. The susceptibility of the IR suppressor unit to cracking is a shortcoming which should be corrected prior to follow-on redesign.

25. When attempting to latch the engine cowling open using the latch provided near the tail boom attachment point, the engine cowling contacted the IR suppressor fairing and could not be latched without deforming the engine cowling. If not latched, the engine cowling could cause damage to the fins on the tailpipe of the suppressor. The IR suppressor installation should allow the engine cowling to be latched open in the same manner as the production UH-1H. The inability to latch the engine cowling in the open position is a shortcoming, which should be corrected prior to follow-on redesign.

26. A small maintenance-inspection door was provided on the left side of the IR suppressor fairing only. To facilitate maintenance and preflight inspections, a door

FIGURE 1
TAILBOOM TEMPERATURE COMPARISON



should be provided on the right side as well. The lack of a maintenance-inspection door on the right side of the suppressor fairing is a shortcoming, which should be corrected prior to follow-on redesign.

Phase II Testing

27. During removal of the new IR suppressor, warpage of the aft outer ring portion of the exhaust ejector (Bell part no. 205-068-217-101) and metal-to-metal contact between the exhaust ejector and suppressor were discovered. Score marks on the leading edge of the IR suppressor struts plus warpage and torn metal at the aft edge at the 1 o'clock position on the exhaust ejector indicates ejector movement of ±1/2 inch against the struts (photos 1 and 2). The IR suppressor struts and exhuast ejector areas were carefully inspected on each daily aircraft inspection. Damage to the above was discovered after 3.1 hours of low speed flight testing and 1.5 hours of ferry flight time to the test site at Bakersfield, California and back. Continued metal-to-metal contact between the engine exhaust ejector and the IR suppressor support struts will cause structural damage to both components and a significant reduction in service life. Should such structural damage go undetected, portions of either component could break loose and cause damage to the airframe. An Equipment Performance Report (EPR) (80-06-1) shown in appendix F was submitted during this test. The metal-to-metal contact between the engine exhaust ejector and the IR suppressor innercore support struts due to the positioning of the IR suppressor is a deficiency which should be corrected prior to further operation with the IR suppressor installed.

28. The IR suppressor (S/N 129-147) exhibited four burned areas on its outer surface immediately aft of the fiberglass fairing (near the trailing edge of the IR suppressor struts). The largest burned area was approximately 6 by 2 inches at the end of Phase II testing (11.2 flight hours). An EPR (80-06-2) was submitted and is shown in appendix F. Further investigation of conditions creating burned areas (hot spots) on the IR suppressor is warranted.

Photo 1. Engine Exhaust Ejector

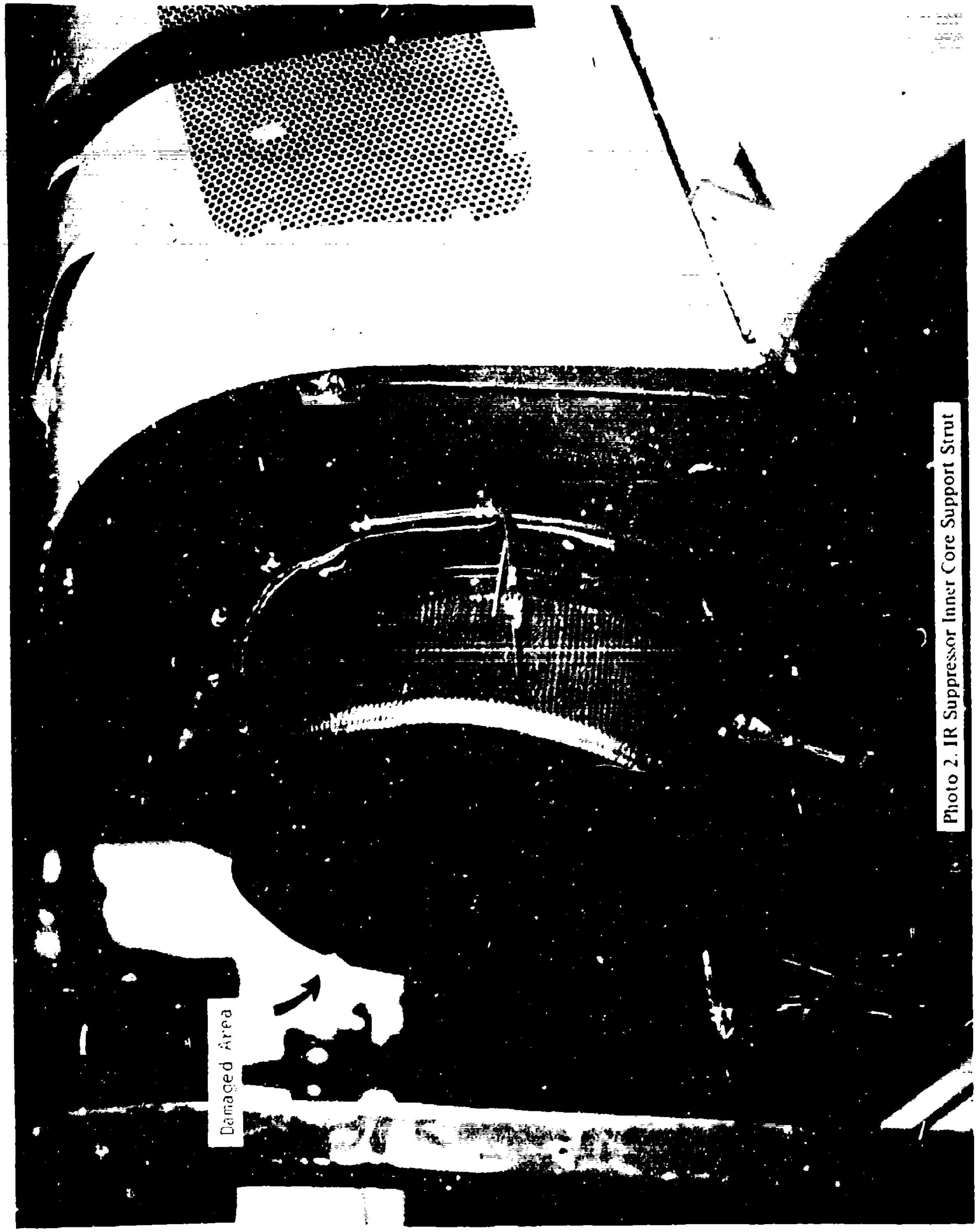


Photo 2. IR Suppressor Inner Core Support Strut

CONCLUSIONS

GENERAL

29. The handling qualities of the UH-1H helicopter were essentially unchanged by the installation of the IR suppressor and jammer (paras 9 and 19).

30. Tailboom surface temperatures were generally higher than those previously reported by BHT for the initial design of the IR suppressor installation (para 22).

31. One deficiency has been identified as a result of the IR suppressor and IR jammer installation on the UH-1H helicopter (para 27).

DEFICIENCY

32. The metal to metal contact between the engine exhaust ejector and the IR suppressor innercore support struts due to the positioning of the IR suppressor unit (para 27).

SHORTCOMINGS

33. The following shortcomings were identified during this test and are listed in the order of importance:

a. The susceptibility of the IR suppressor unit to cracking (para 24)

b. The inability to latch the engine cowling in the open position (para 25)

c. The lack of a maintenance-inspection door on the right side of the suppressor fairing (para 26).

SPECIFICATION COMPLIANCE

34. No new specification non-compliances were identified for the UH-1H as a result of the IR suppressor and jammer installation.

RECOMMENDATIONS

35. The following recommendations are made:

a. Correct the deficiency listed in paragraph 32 prior to further operation with IR suppressor installed (para 27)

b. Correct the shortcomings listed in paragraph 33 in follow-on redesign

c. Investigate the structual implications of the high (maximum of 340° F observed) tailboom temperatures observed during this test in follow-on redesign (para 22)

d. Investigate the effects of the burned areas (hot spots) on the effectiveness and serviceability of the IR suppressor unit (para 28).

APPENDIX A. REFERENCES

1. Letter, AVRADCOM, DRDAV-DI, 21 November 1980, subject: Preliminary Airworthiness Evaluation (PAE) of the UH-1H with Hot Metal Plus Plume (HMPP) Infrared (IR) Suppressor and IR Jammer.

2. Test Plan, USAAEFA Project No. 80-06, *Preliminary Airworthiness Evaluation of UH-1H with Hot Metal Plus Plume Infrared Suppressor and Infrared Jammer,* Revision No. 1, December 1980.

3. Letter, AVRADCOM, DRDAV-DI, 2 February 1981, subject: Airworthiness Release for USAAEFA to Conduct a Preliminary Airworthiness Evaluation (PAE) of the JUH-1H Helicopter, S/N 69-15532 Equipped with a Garrett Hot Metal Plus Plume (HMPP) Suppressor and a AN/ALQ-144 Infrared (IR) Jammer, Project No. 80-06.

4. Operator's Manual, TM 55-1520-210-10, *US Army Models UH-1D/H and EH-1H Helicopters,* 18 May 1979, Change 10, 17 February 1981.

5. Detail Specification, Bell Helicopter Textron, No. 205-947-177, *UH-1H Utility Helicopter FY-74 Procurement,* 15 May 1973.

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APPENDIX B. DESCRIPTION

GENERAL

1. The test helicopter, US Army S/N 69-15532, was a production UH-1H modified to accomodate test instrumentation and the IR suppressor and IR jammer installation. The principal structural modification was the redesign of the aft engine cowling to provide support for the HMPP IR suppressor and the AN/ALQ-144 IR jammer. Photos 1 through 4 show the test aircraft with the IR suppressor, IR jammer and test instrumentation installed.

IR SUPPRESSOR SYSTEM

2. The IR suppressor installation consisted of four major components: the engine exhaust ejector (photo 5), the IR suppressor unit (photo 6), and an AN/ALQ-144 jammer (photo 7) which was mounted on top of the cowling assembly (photo 8). The IR suppressor is a plug-type suppressor manufactured by the Garrett AiResearch Manufacturing Company. The suppresor uses the size and shape of the plug to hide the hot engine parts. The suppressor also had circumferentially oriented vents to act as an ejector to entrain compartment and ambient air to mix with the engine exhaust, thereby reducing exhaust gas temperature. Airflow through the engine was extended aft and upward by the exhaust ejector and the IR suppressor. An insulation blanket was installed on the engine exhaust ejector.

3. The weight of the complete installation was approximately 127 pounds. The weight of the original aircraft components replaced by the suppressor/jammer installation was approximately 26 pounds for a net weight increase of 101 pounds. The aircraft basic weight and longitudinal center of gravity location (with test instrumentation and IR suppressor and jammer installed) was 5930 pounds at FS 142.0.

4. The IR suppressor and IR jammer installation evaluated during this program was a redesign of a previous installation which was reported to have caused a significant degredation in directional stability (ref 9, app A). The redesigned installation allowed both the IR suppressor and the IR jammer to be lowered in order to reduce the airflow disturbance over the vertical stabilizer.

FLIGHT ENVELOPE

5. The JUH-1H with the IR suppressor and IR jammer installed was cleared for flight within the flight envelope specified in the operator's manual (ref 6, app A).

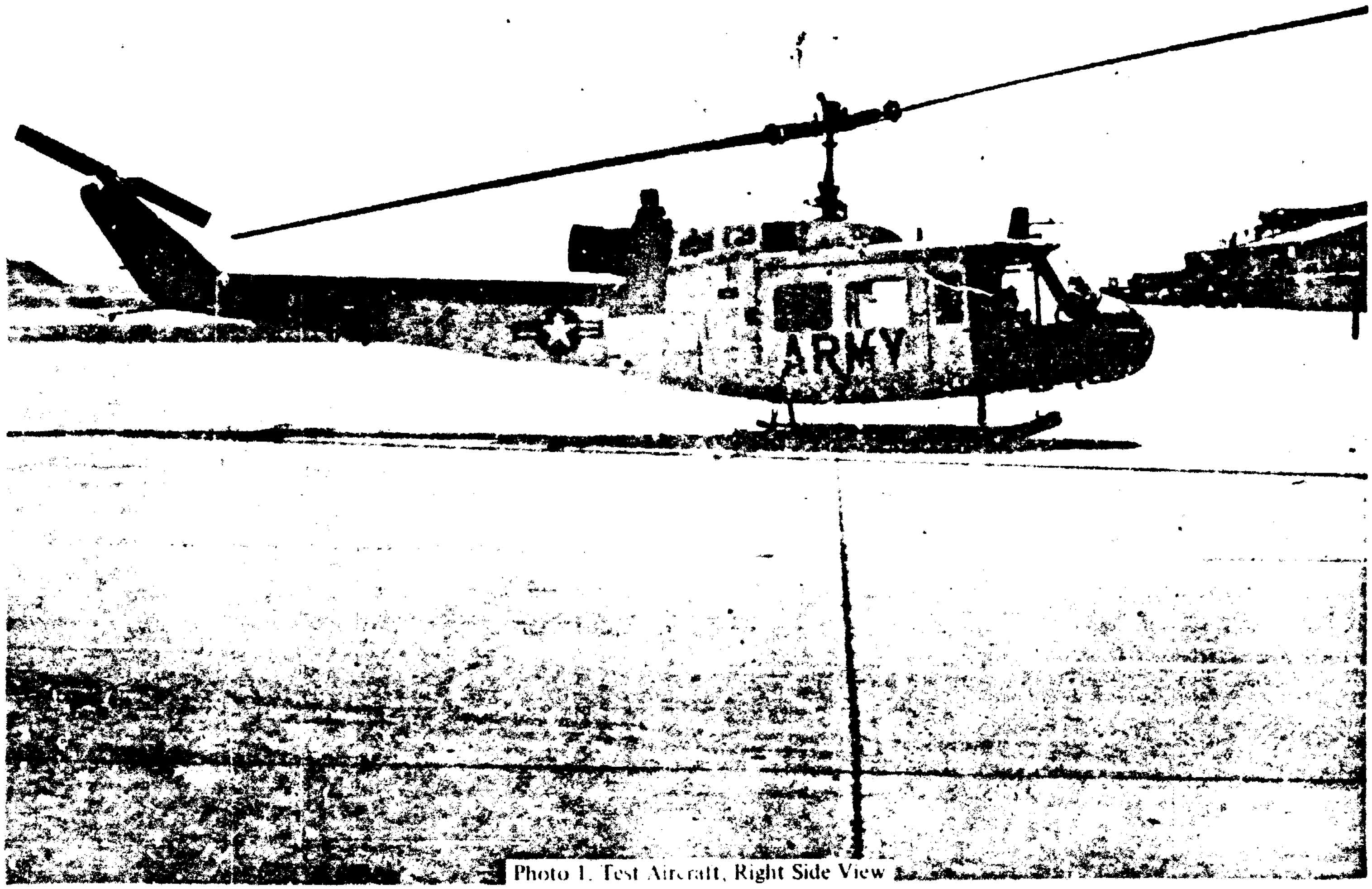


Photo 1. Test Aircraft, Right Side View

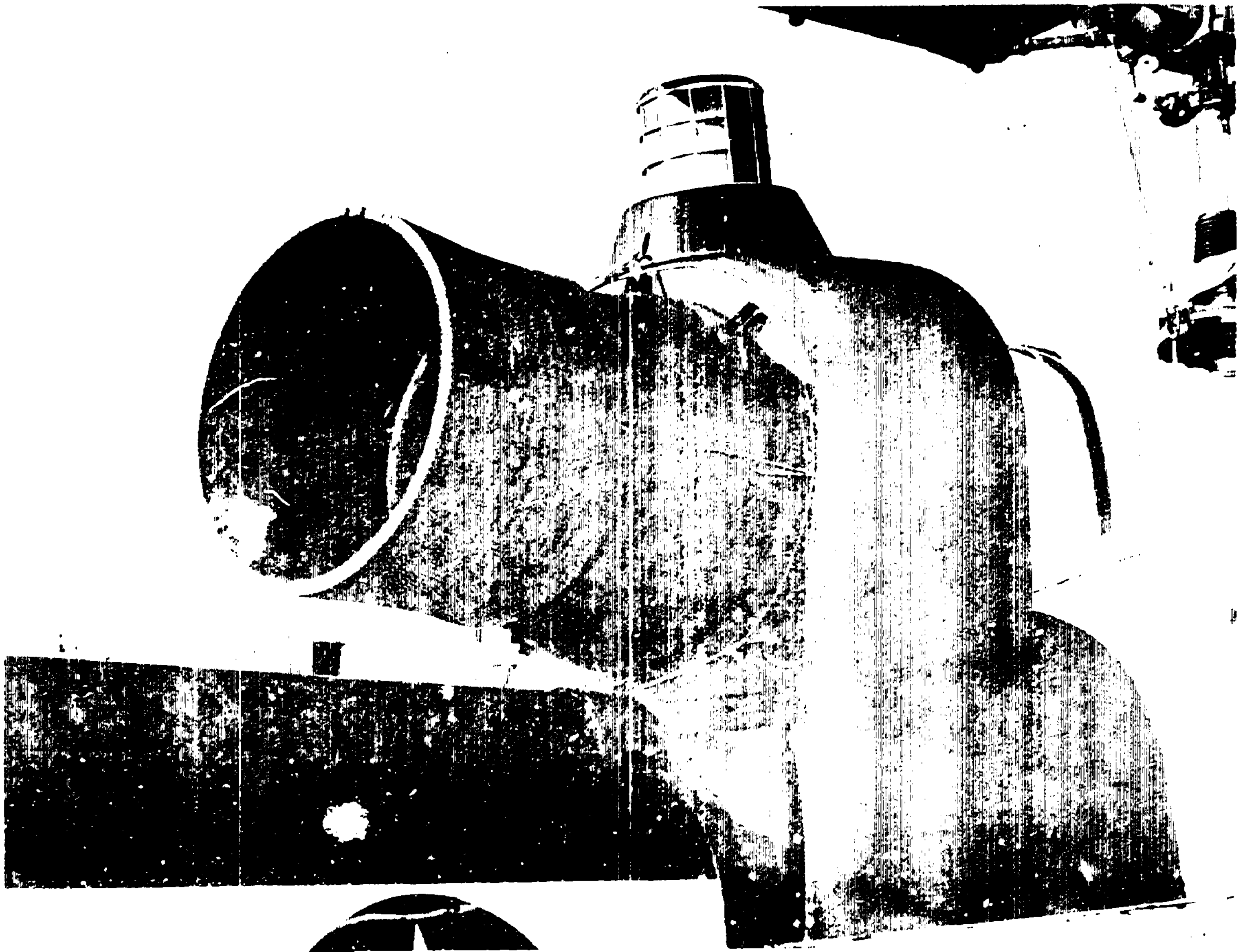


Photo 2. IR Suppressor Installation Right Rear Quartering View

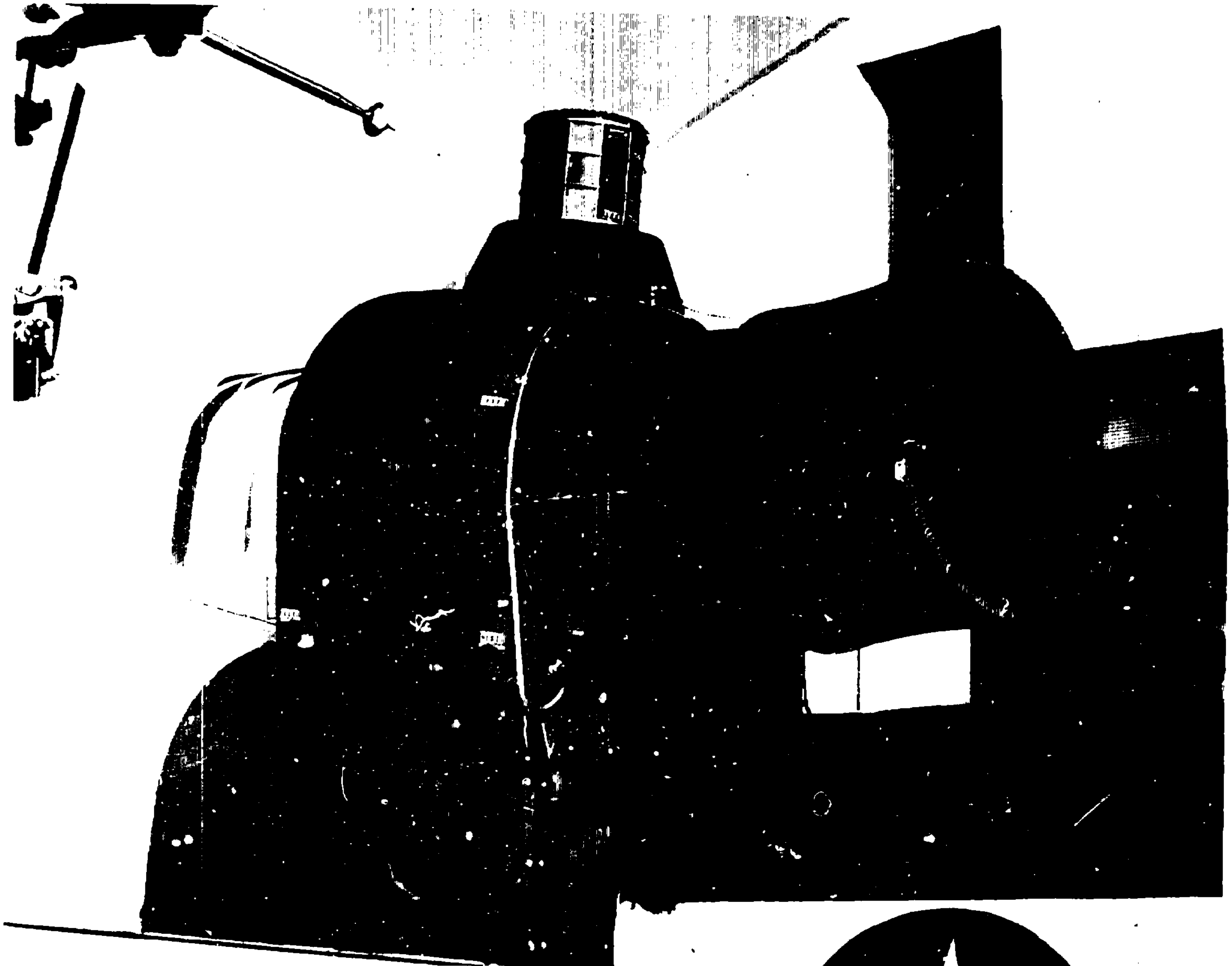


Photo 3. IR Suppressor Installation, Left-Rear Quartering View

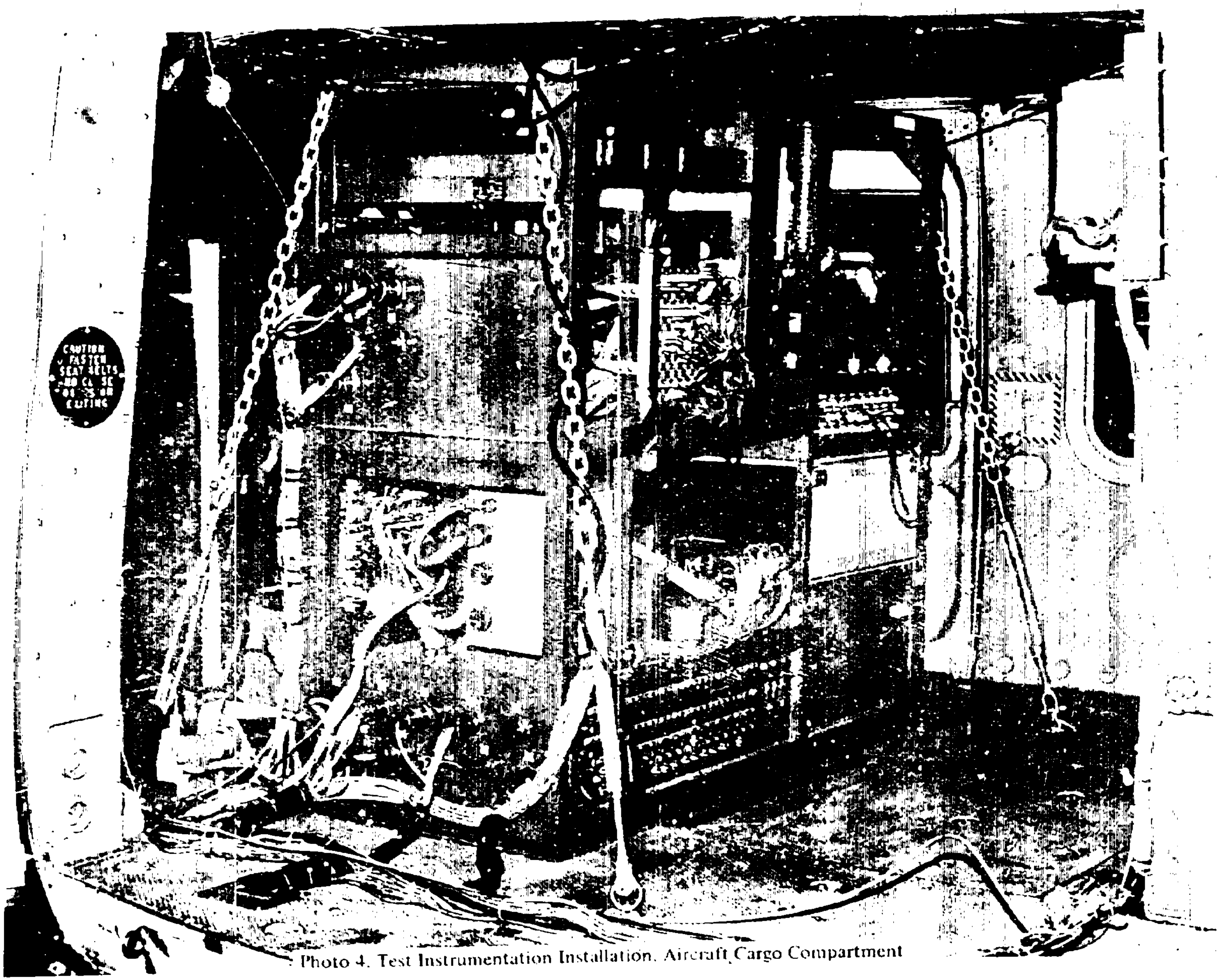


Photo 4. Test Instrumentation Installation, Aircraft Cargo Compartment

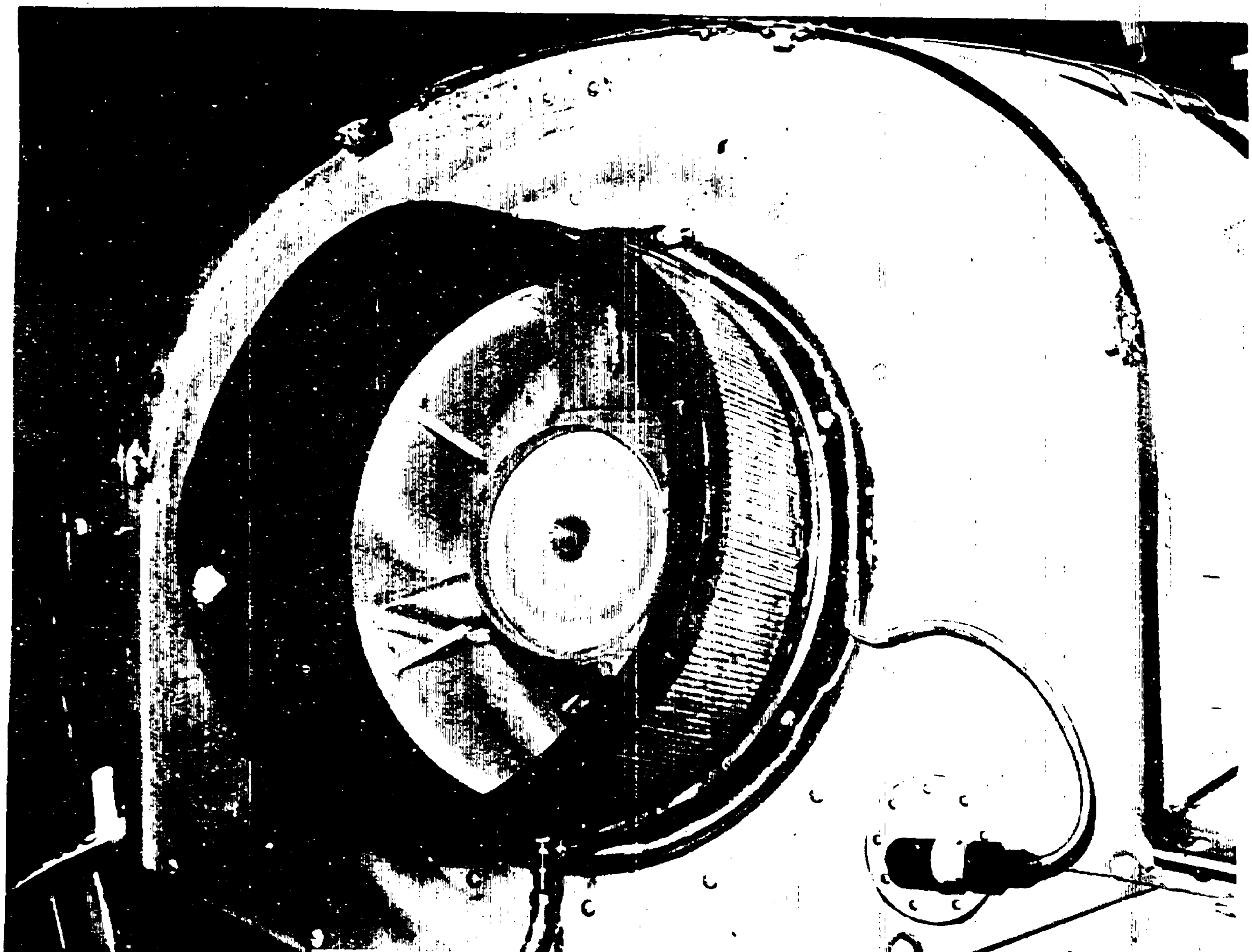


Photo 5. Engine Exhaust Ejector, Cowling and IR Suppresor Removed

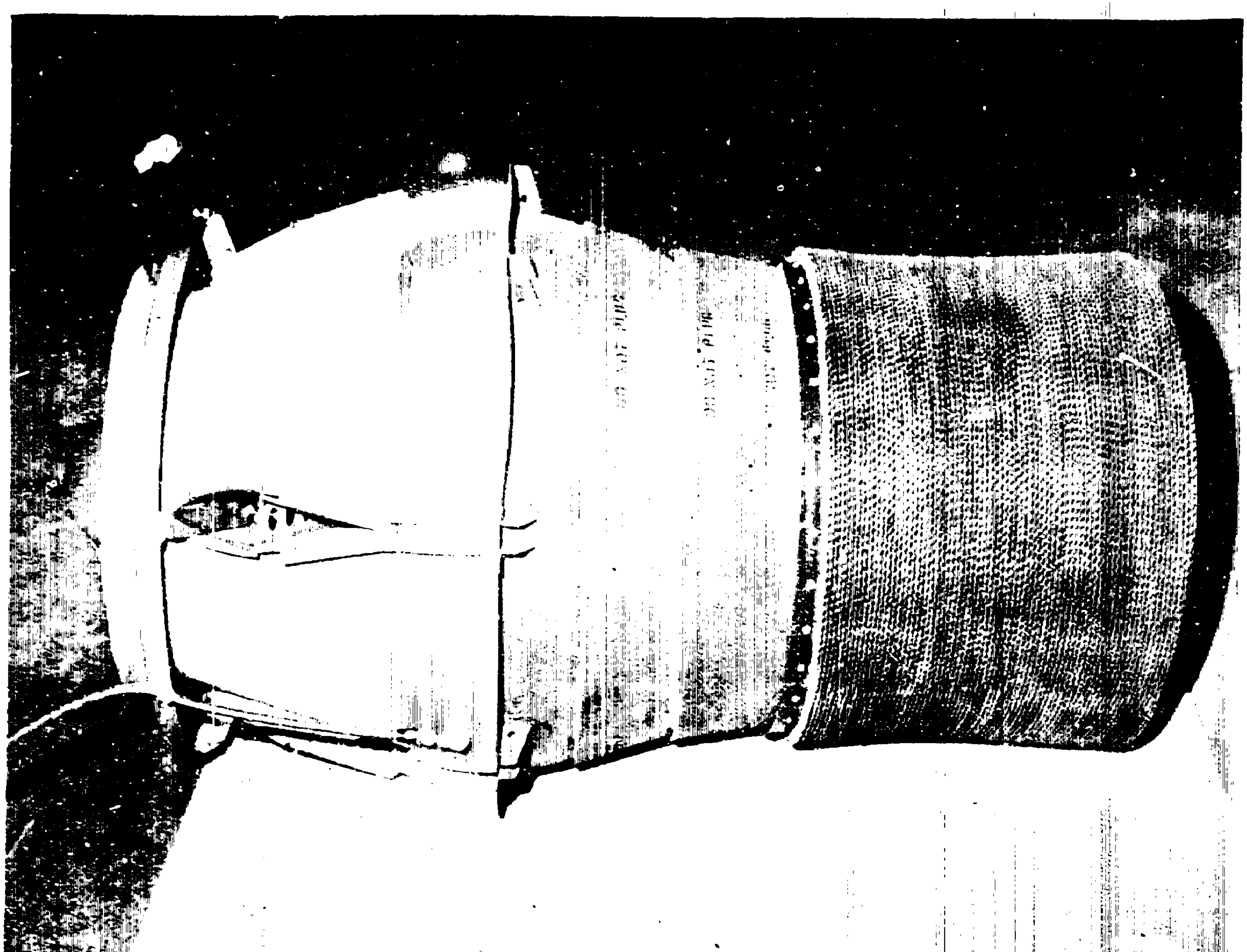


Photo 6. IR Suppressor Unit

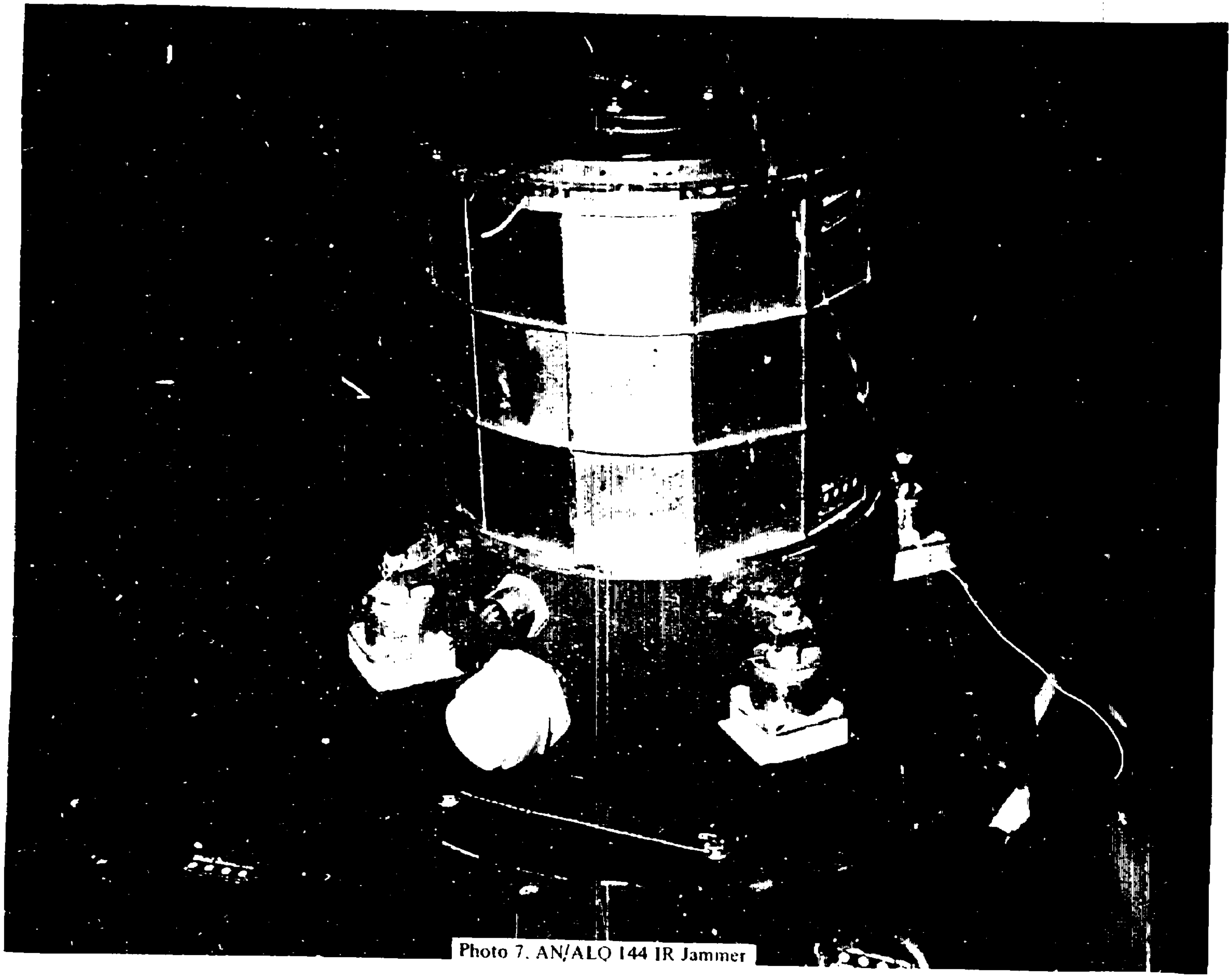


Photo 7. AN/ALQ 144 IR Jammer

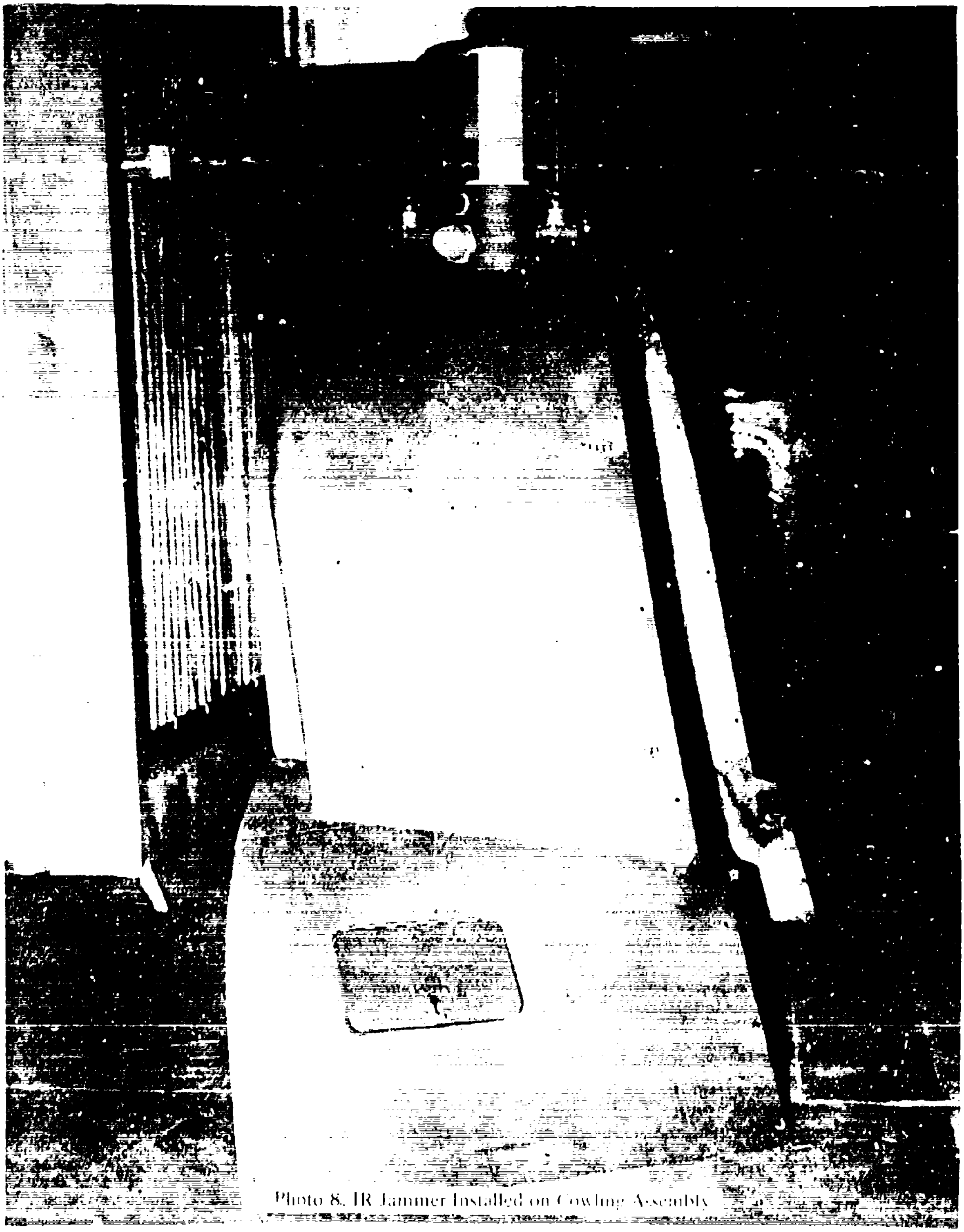


Photo 8. IR Jammer Installed on Cowling Assembly

APPENDIX C. INSTRUMENTATION

The airborne data aquisition system was installed, calibrated and maintained by USAAEFA. The system used pulse code modulation (PCM) encoding for standard handling qualities data and pressure data. Magnetic tape was used to record parameters on board the aircraft. A test instrumentation boom was mounted at the base of the aircraft windshield and extended forward for 9.5 feet. A swiveling pitot static tube and angle of attack and sideslip vanes were mounted on the boom. Temperature data were recorded by hand from a manually selectable digital display. A total of 24 thermocouples supplemented by temperature sensitive tapes were used. Pressure data were obtained using an electro/mechanical scanivalve which sequentially sampled the differential pressure. The dwell time at each sampling port was 0.5 second. Instrumentation and related special equipment installed in the aircraft and used for this test are:

<u>Pilot Station</u>

Event switch

<u>Copilot Station</u>

Instrumentation controls and displays
Event switch
Control fixture (jig)

<u>Displayed on Instrument Panel</u>

Airspeed (boom and ship's system)
Altitude (boom and ship's system)
Angle of sideslip
Free air temperature
Control position
    Longitudinal
    Lateral
    Directional
    Collective
Rotor speed
Engine torque
Fuel used
Tape correlation counter

<u>Hand Recorded</u>

Temperatures (shown in table 2)
Oil cooler inlet air temperature

<u>Recorded on Tape</u>

Airspeed (boom system)
Altitude (boom system)
Angle of sideslip
Angle of Attack
Free air temperature
Control positions
    Longitudinal

Lateral
Directional
Collective
Rotor speed
Engine torque
Fuel used
Tape correlation counter
Pitch attitude
Pitch rate
Roll attitude
Roll rate
Aircraft heading
Yaw rate
Throttle position
Pilot's event
Copilot's event
Center of gravity normal acceleration
Longitudinal
Lateral
Time
Pressures (shown in table 1)

Table 1. Pressure Sensor Locations

Pressure Port No.	Type of Measurement	Pressure Port Location
1	Static pressure	3 o'clock - 2 inches standoff at mouth of suppressor (FS 213.3)
2	Static pressure	6 o'clock - 2 inches standoff at mouth of suppressor perpendicular to centerline through (FS 213.2)
3	Static pressure	9 o'clock - 2 inches standoff at mouth of suppressor (FS 213.2)
4	Static pressure	12 o'clock - 2 inches standoff at mouth of suppressor perpendicular to centerline through FS 213.2
5	Static pressure	3 o'clock - 1 inch standoff from suppressor at FS 223.7
6	Static pressure	6 o'clock - 1 inch standoff from suppressor perpendicular to centerline through FS 223.7
7	Static pressure	9 o'clock - 1 inch standoff from suppressor at FS 223.7
8	Static pressure	12 o'clock - 1 inch standoff from suppressor perpendicular to centerline through FS 223.7
9	Total pressure	3 o'clock - surface of suppressor at first inlet
10	Total pressure	6 o'clock - surface of suppressor at first inlet
11	Total pressure	9 o'clock - surface of suppressor at first inlet
12	Total pressure	12 o'clock - surface of suppressor at first inlet
13	Total pressure	3 o'clock - surface of suppressor at second inlet
14	Total pressure	6 o'clock - surface of suppressor at second inlet
15	Total pressure	9 o'clock - surface of suppressor at second inlet

16	Total pressure	12 o'clock - surface of suppressor at second inlet
17	Total pressure	3 o'clock - surface of suppressor at third inlet
18	Total pressure	6 o'clock - surface of suppressor at third inlet
19	Total pressure	9 o'clock - surface of suppressor at third inlet
20	Total pressure	12 o'clock - surface of suppressor at third inlet
21	Static pressure	Aircraft static (boom system)

NOTE: Suppressor pressure sensor locations are illustrated in figure 1.

Table 2. Thermocouple and Temperature Tape Locations

Thermocouple[1] Number	Type of Measurement	Thermocouple Location
1	Surface temperature	9 o'clock - engine exhaust duct (FS 213.3)
2	Surface temperature	3 o'clock - engine exhaust duct (FS 213.3)
3	Air temperature	9 o'clock - between mouth of suppressor and engine exhaust duct (FS 215.3)
4	Air temperature	3 o'clock - between mouth of suppressor and engine duct (FS 215.3)
5	Air temperature	9 o'clock - 1 inch from suppressor surface at FS 223.7
6	Air temperature	12 o'clock - 1 inch from suppressor surface perpendicular to centerline of suppressor through FS 223.7
7	Air temperature	3 o'clock - 1 inch from suppressor surface at FS 223.7
8	Air temperature	6 o'clock - 1 inch from suppressor perpendicular to centerline of suppressor through FS 223.7
9	Air temperature	6 o'clock - between mouth of suppressor and engine centerline of suppressor through FS 236.2
10	Air temperature	Inlet to the oil cooler blower
11 - 24	Surface temperature	As illustrated in figure 2
Temperature Tape Number		
24 - 45	Surface temperature	As illustrated in figure 2

NOTE: Suppressor thermocouple locations illustrated in figure 1.

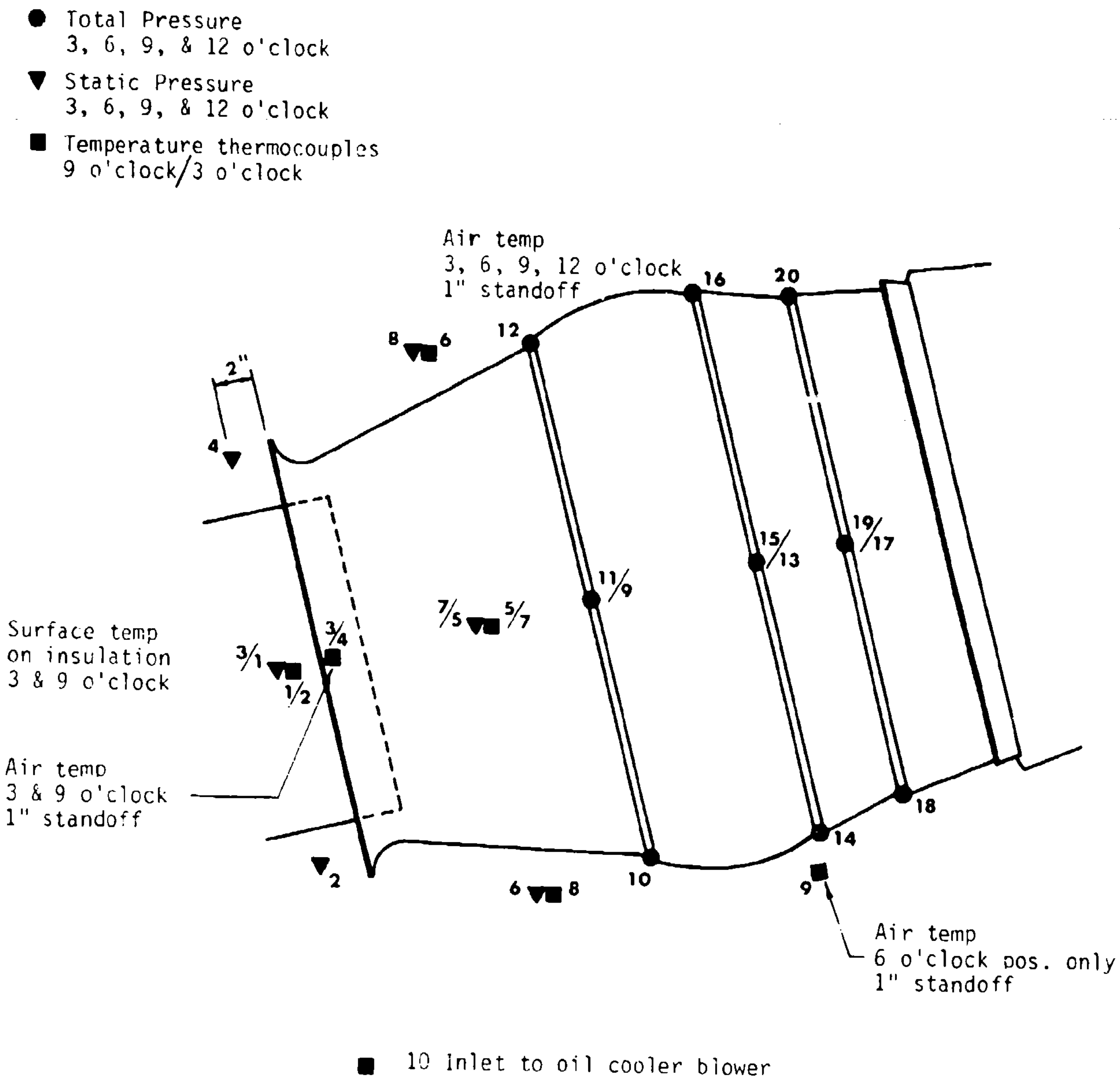


Figure 1

Pressure and Temperature sensor locations

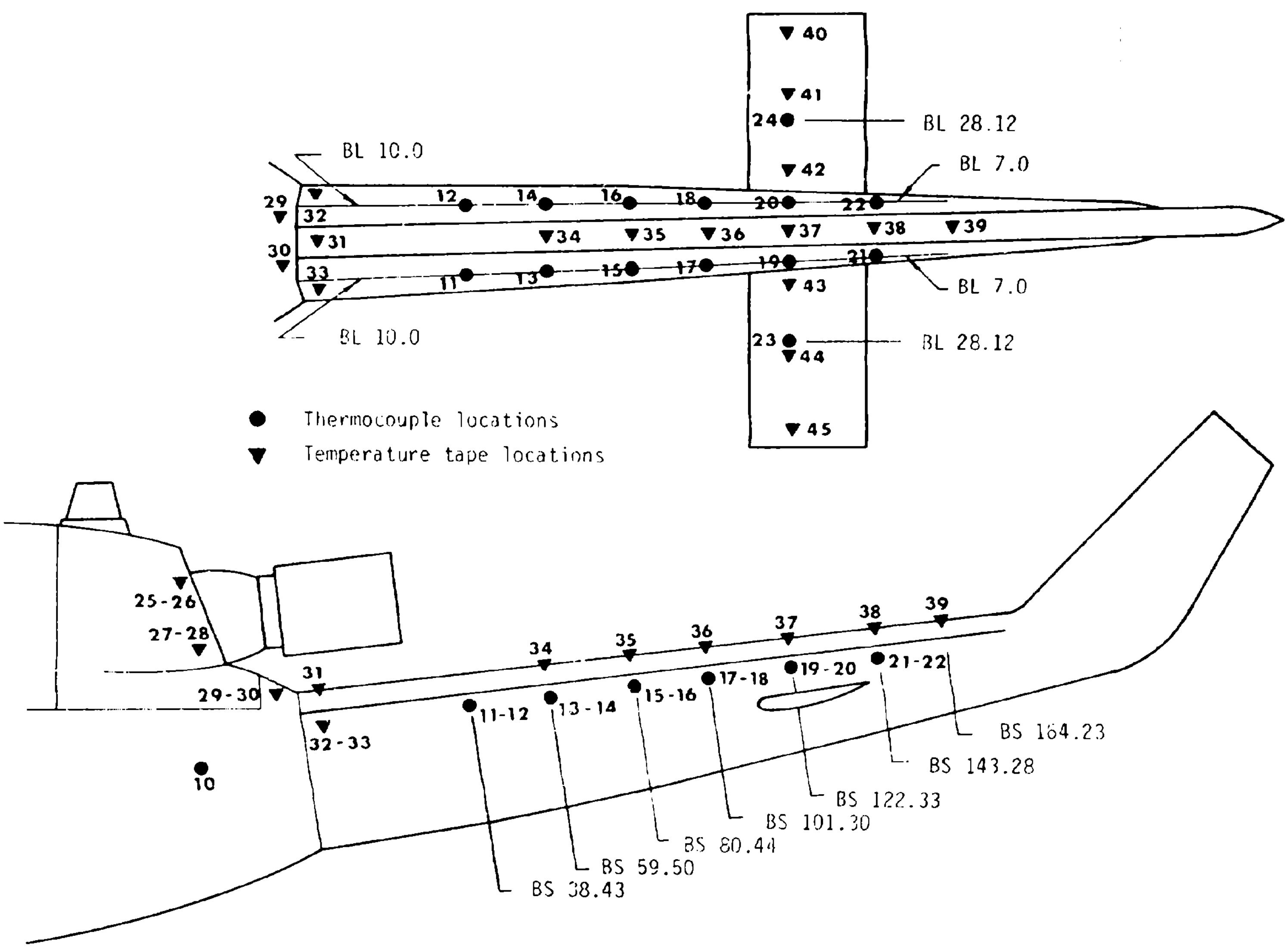


FIGURE 2
THERMOCOUPLE AND TEMPERATURE TAPE LOCATIONS

APPENDIX D. TEST TECHNIQUES AND DATA ANALYSIS METHODS

HANDLING QUALITIES

1. Stability and control data were collected and evaluated using standard test methods as described in reference 10, appendix A.

2. The Handling Qualities Rating Scale (HQRS) presented in figure 1 was used to augment pilot comments relative to pilot workload.

PRESSURE/TEMPERATURE SURVEY

3. Pressures were recorded during stabilized flight conditions using PCM instrumentation. IR suppressor pressures were referenced to aircraft boom static pressure by means of a differential pressure transducer and scanivalve. A total of 20 pressure ports on the scanivalve were used to sample the differential pressure. Pressures were measured in pounds per square inch differential (psid) and values determined by averaging the pressures recorded for each port using data plots similar to the one shown in figure 2. The location of each pressure sensor is shown in table 1, appendix C.

4. Temperatures were hand recorded from a selectable digital display. A total of 24 thermocouples were used. Temperature sensitive tapes were used to supplement thermocouple readings. The locations of the therocouples and temperature sensitive tapes are shown in table 2, appendix C.

AIRSPEED CALIBRATION

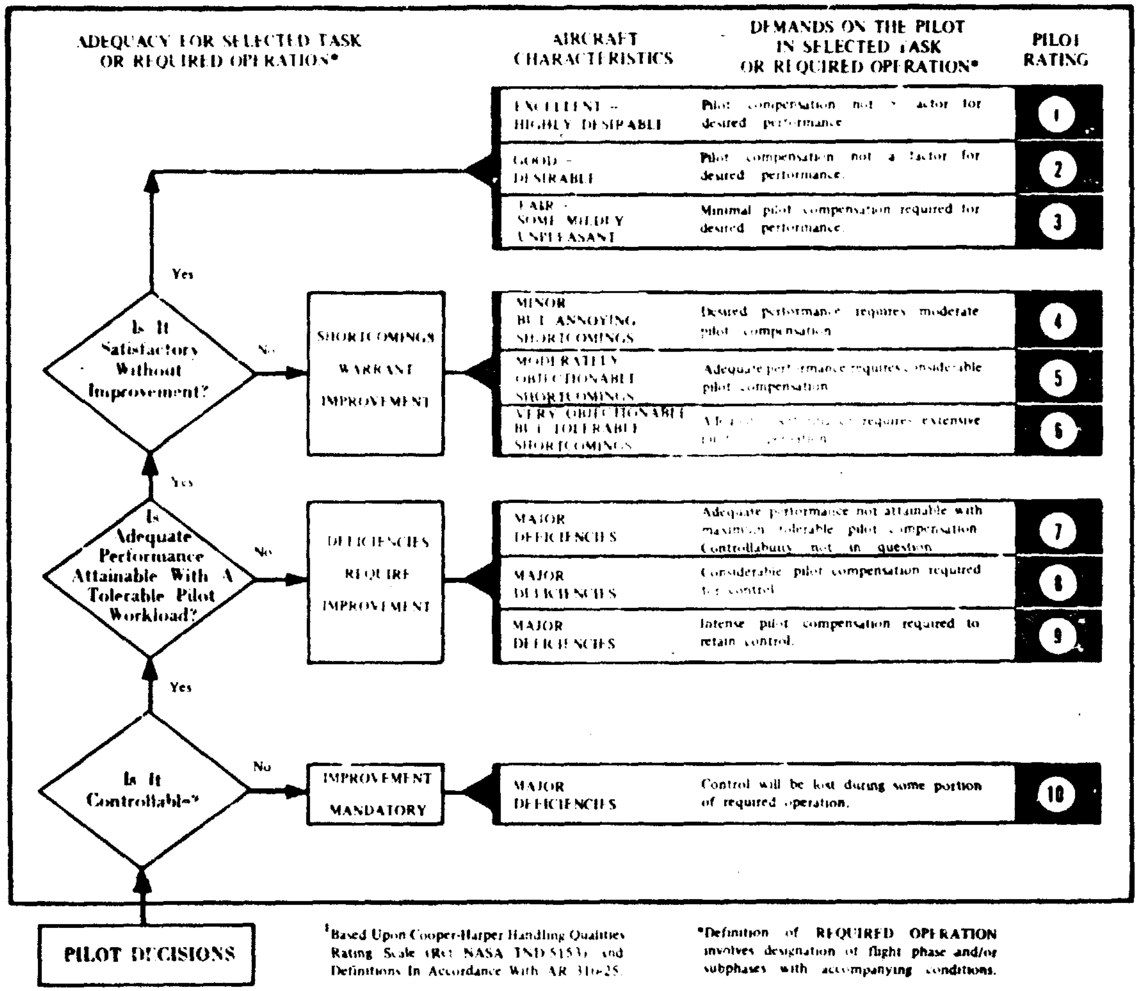
5. Calibrated airspeed was obtained by correcting indicated airspeed using instrument and position error corrections. The airspeed from the boom system was used for all data reduction. The calibration for the boom airspeed system used during this test is shown in figure 3.

DEFINITIONS

6. Definitions of deficiencies and shortcomings used during this test are shown below.

a. Deficiency - A defect or malfunction discovered during the life cycle of an item of equipment that constitutes a safety hazard to personnel; will result in serious damage to the equipment if operation is continued; or indicates improper design or other cause of failure of an item or part, which seriously impairs the equipment's operational capability.

b. Shortcoming - An imperfection or malfunction occurring during the life cycle of equipment which must be reported and which should be corrected to increase efficiency and to render the equipment completely serviceable. It will not cause an immediate breakdown, jeopardize safe operation, or materially reduce the useability of the material or end product.



[1] Based Upon Cooper-Harper Handling Qualities Rating Scale (Ref NASA TND 5153) and Definitions In Accordance With AR 310-25.

*Definition of REQUIRED OPERATION involves designation of flight phase and/or subphases with accompanying conditions.

Figure 1. Handling Qualities Rating Scale

FIGURE 2
UH-1H IR SUPPRESSOR
SCANIVALVE DATA

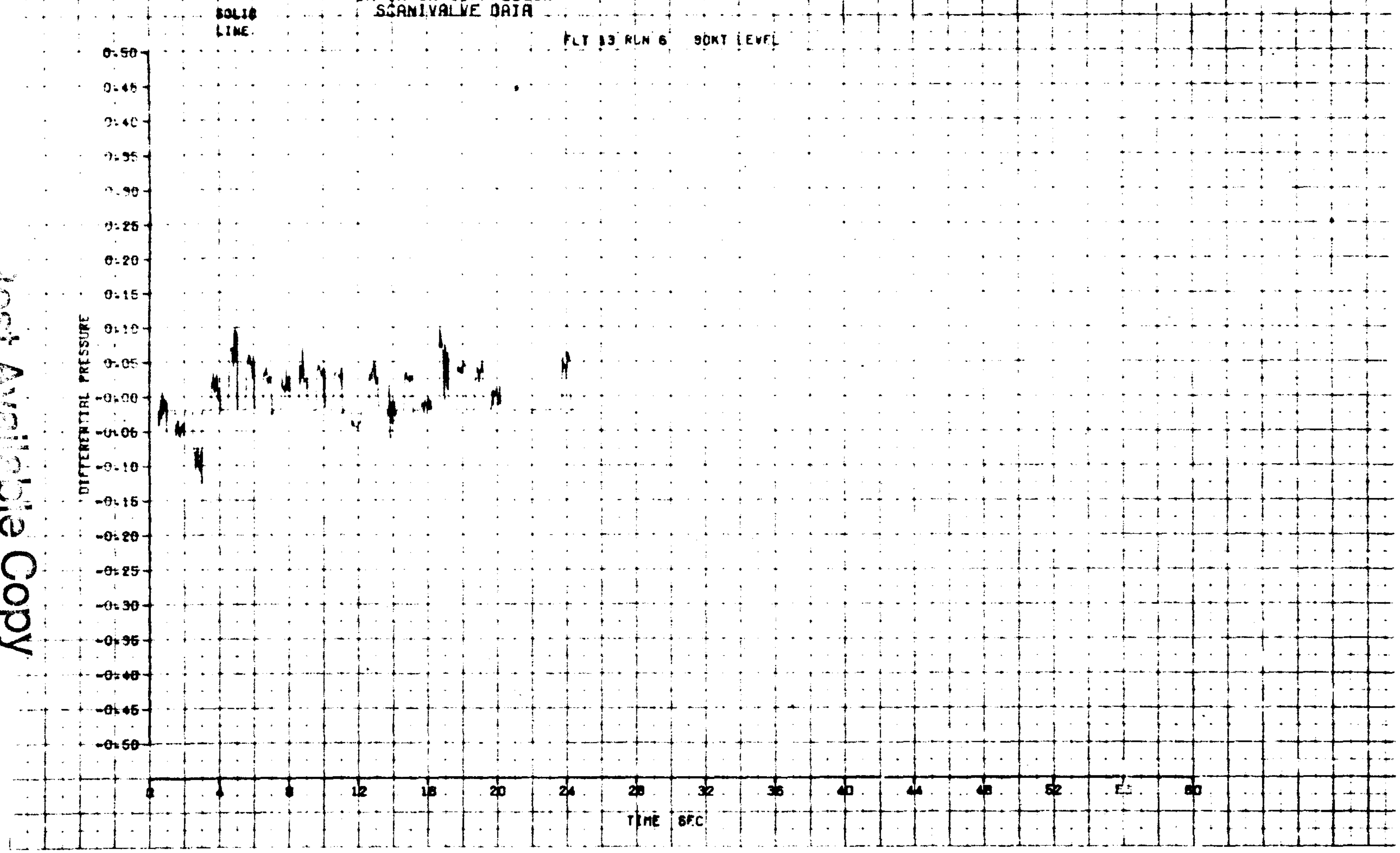
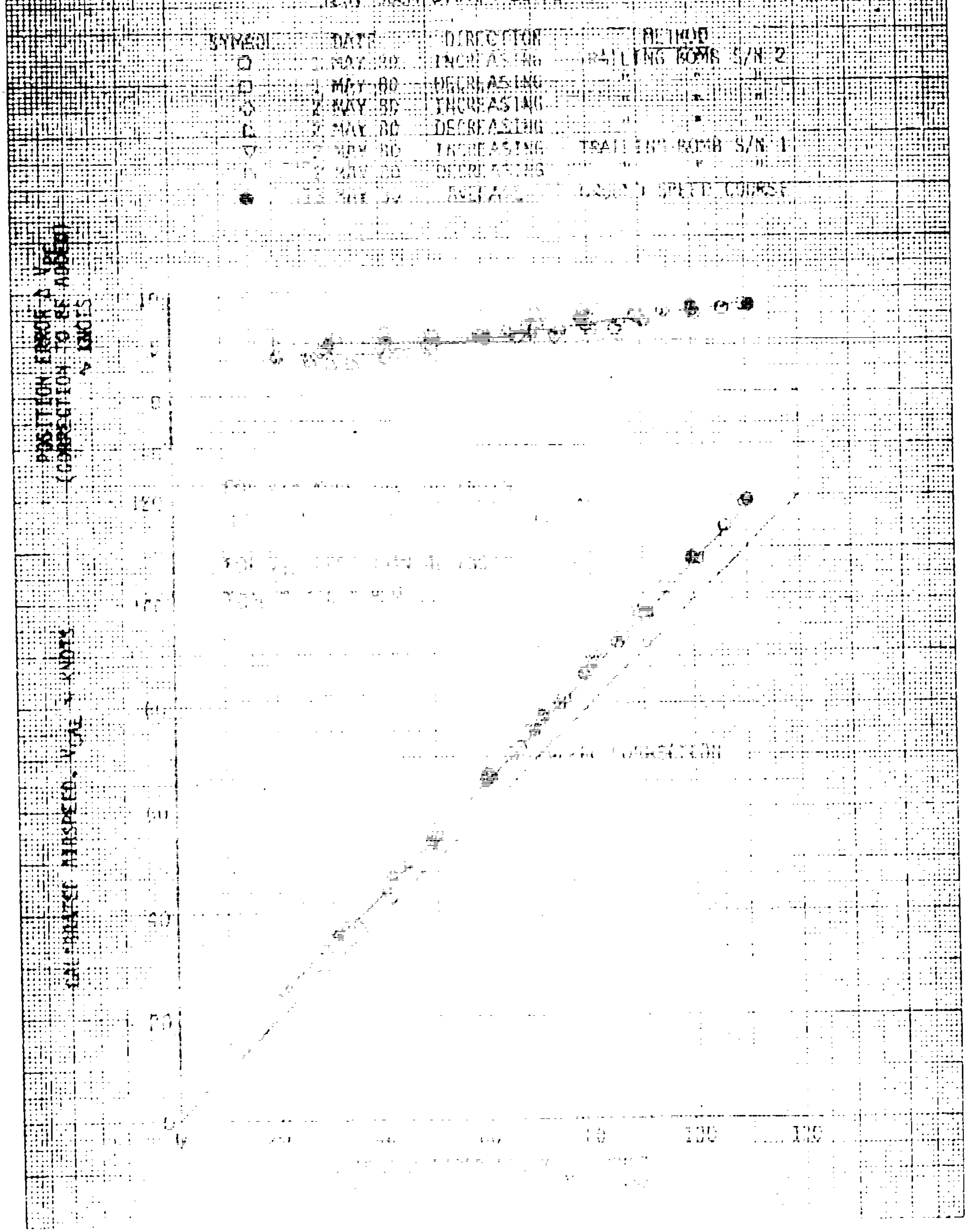


FIGURE 3
AIRSPEED CALIBRATION
JUH-1H USA S/N 69-15532
TEST BOOM SYSTEM LEVEL FLIGHT



APPENDIX E. TEST DATA

INDEX

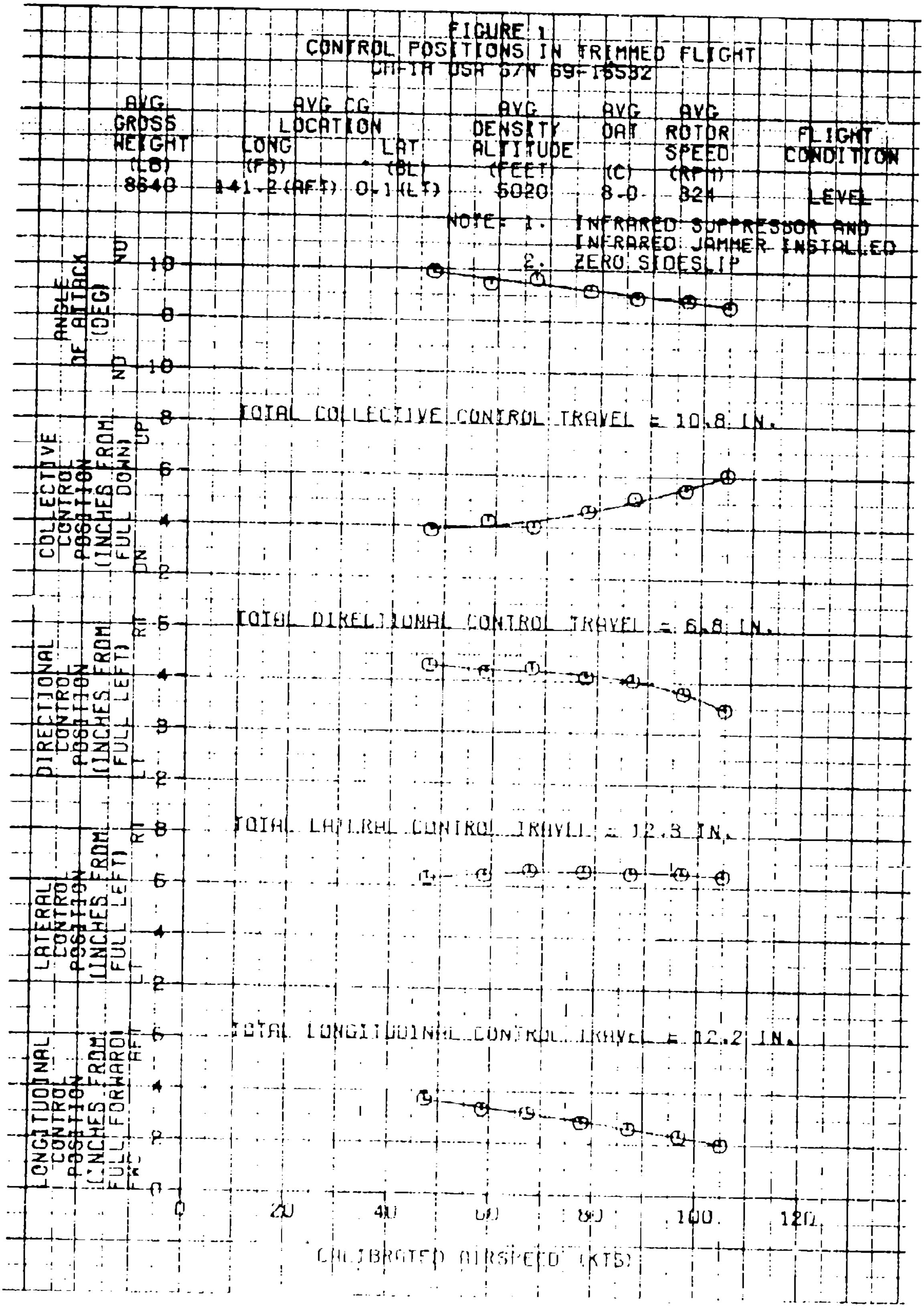


FIGURE 1
CONTROL POSITIONS IN TRIMMED FLIGHT
UH-1H USA S/N 69-15532

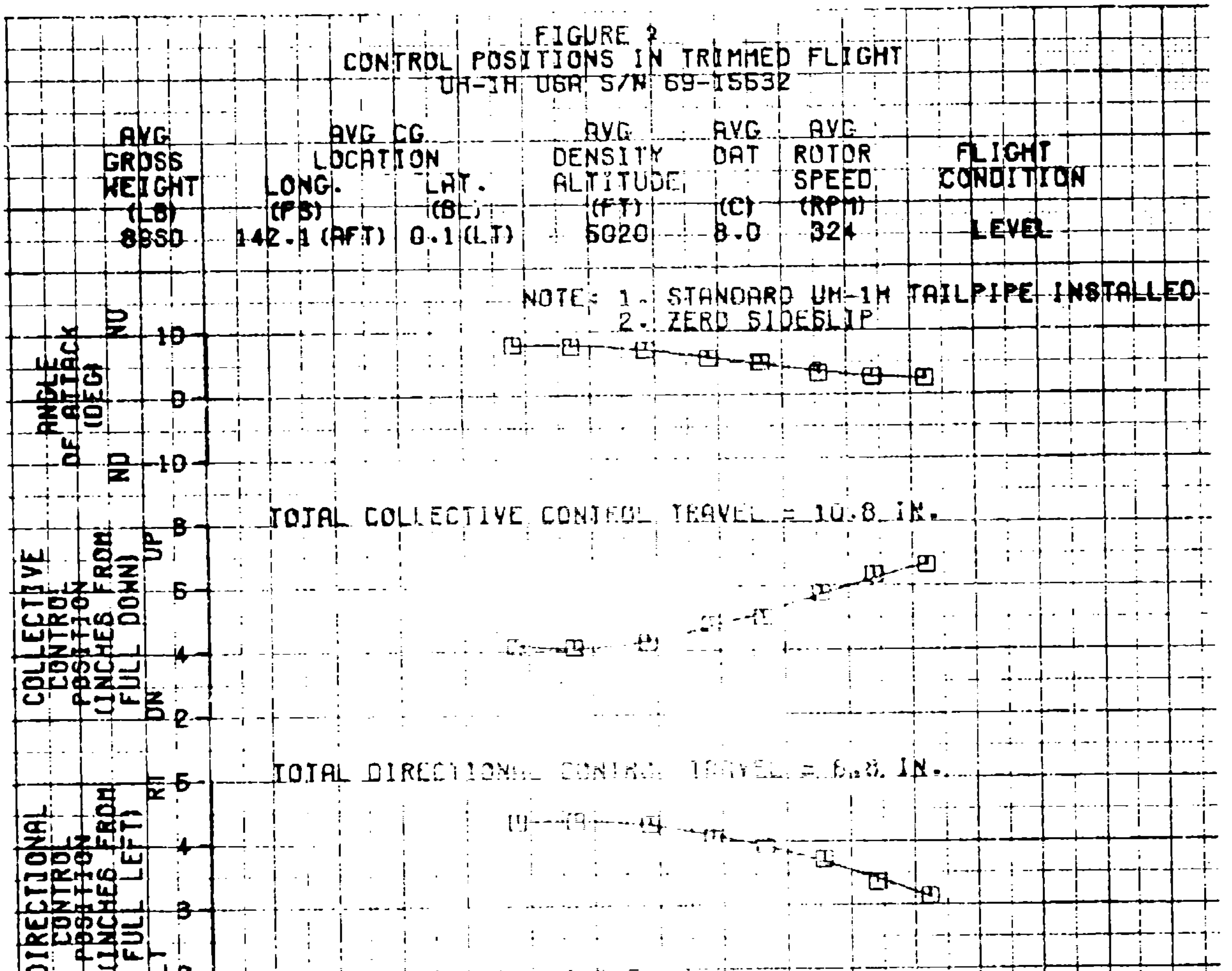


FIGURE 2
CONTROL POSITIONS IN TRIMMED FLIGHT
UH-1H USA S/N 69-15532
AVG GROSS WEIGHT (LB) 8850
AVG CG LOCATION LONG. (FS) 142.1 (AFT)
LAT. (BL) 0.1 (LT)
AVG DENSITY ALTITUDE (FT) 5020
AVG OAT (C) 8.0
AVG ROTOR SPEED (RPM) 324
FLIGHT CONDITION LEVEL
NOTE: 1. STANDARD UH-1H TAILPIPE INSTALLED
2. ZERO SIDESLIP
ANGLE OF ATTACK (DEG)
NU
ND
TOTAL COLLECTIVE CONTROL TRAVEL = 10.8 IN.
COLLECTIVE CONTROL POSITION (INCHES FROM FULL DOWN)
UP
DN
TOTAL DIRECTIONAL CONTROL TRAVEL = 6.8 IN.
DIRECTIONAL CONTROL POSITION (INCHES FROM FULL LEFT)
RT
LT
TOTAL LATERAL CONTROL TRAVEL = 12.3 IN.
LATERAL CONTROL POSITION (INCHES FROM FULL LEFT)
RT
LT
TOTAL LONGITUDINAL CONTROL TRAVEL = 12.2 IN.
LONGITUDINAL CONTROL POSITION (INCHES FROM FULL FORWARD)
AFT
FWD
CALIBRATED AIRSPEED (KTS)

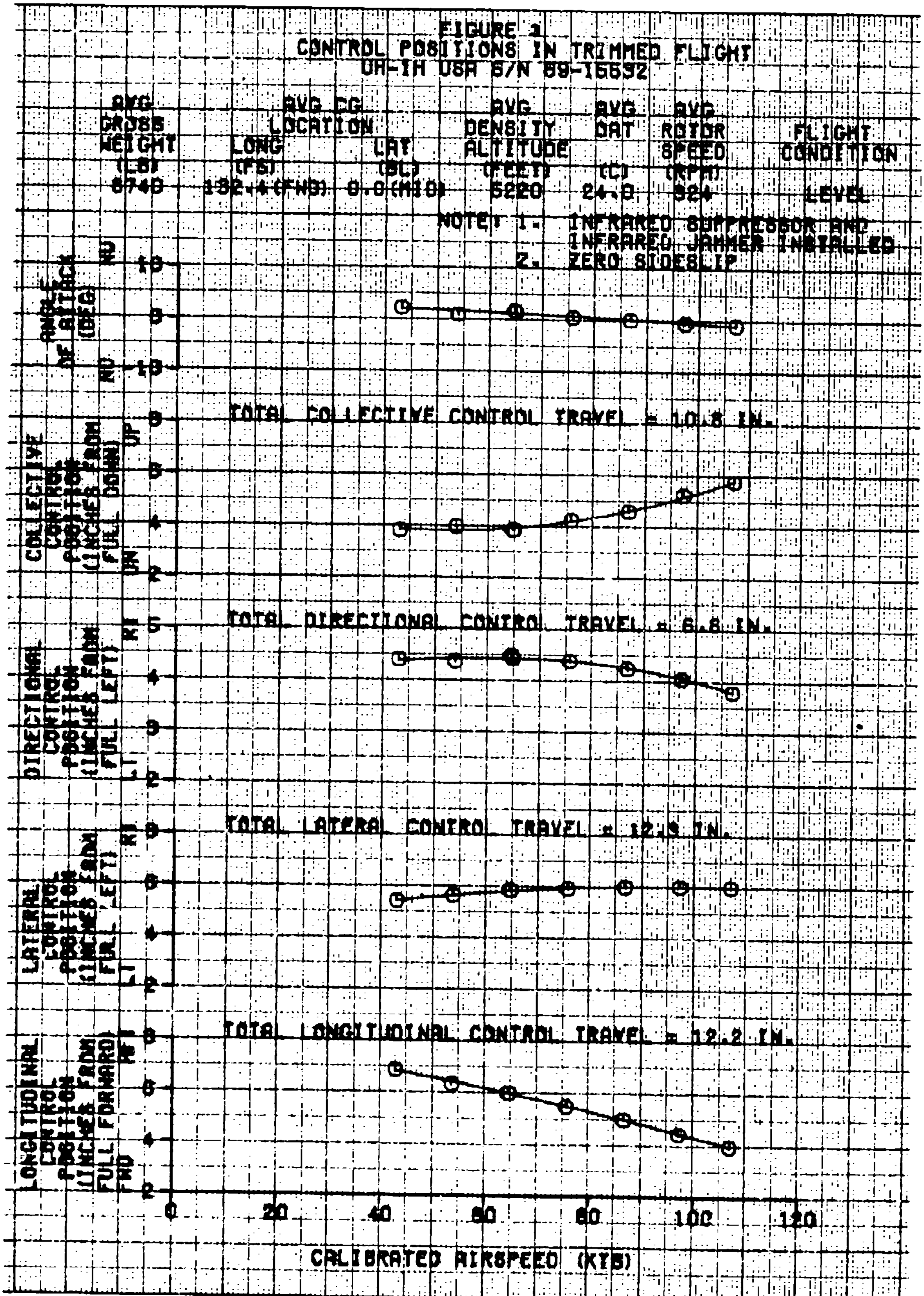
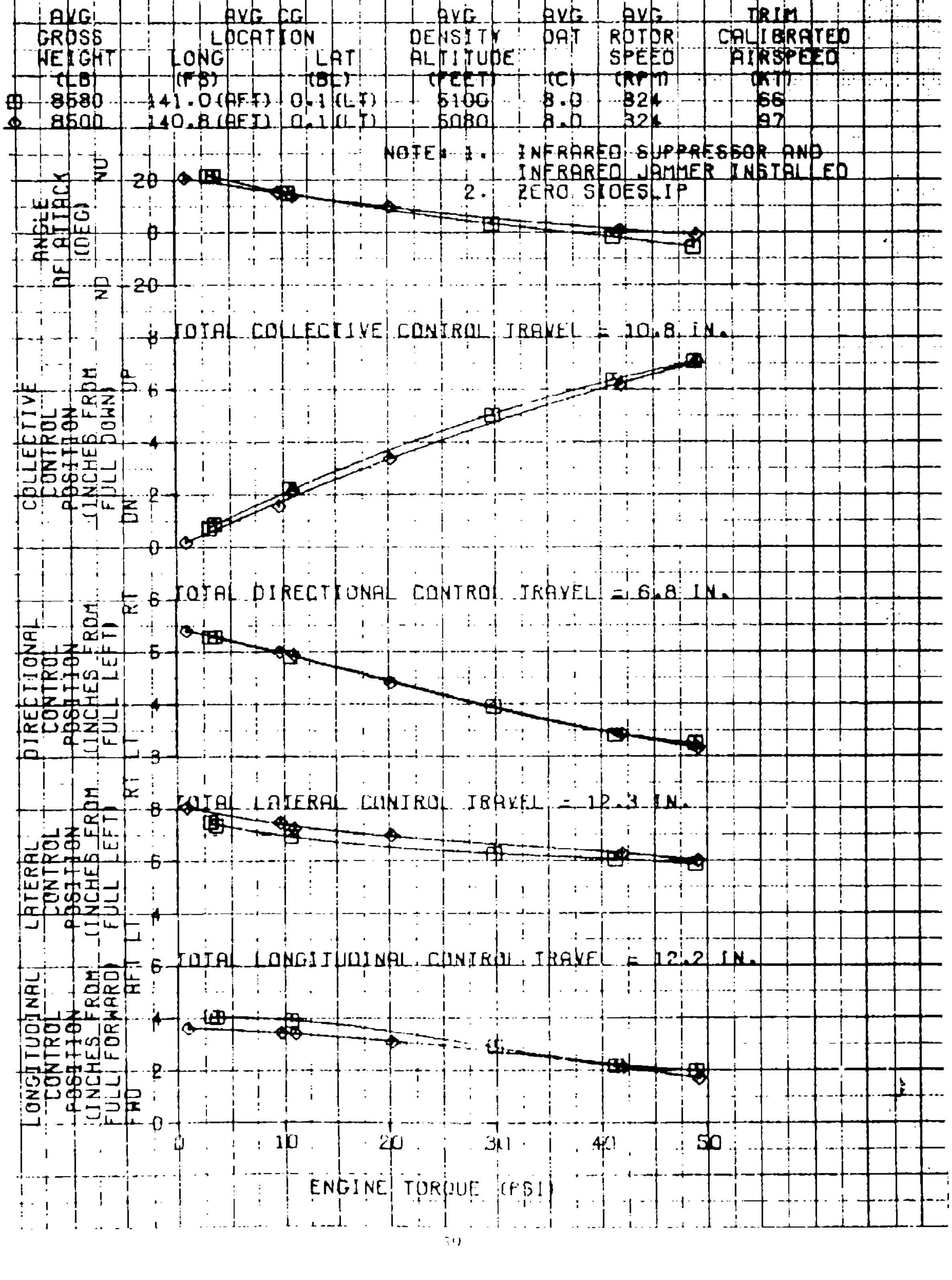
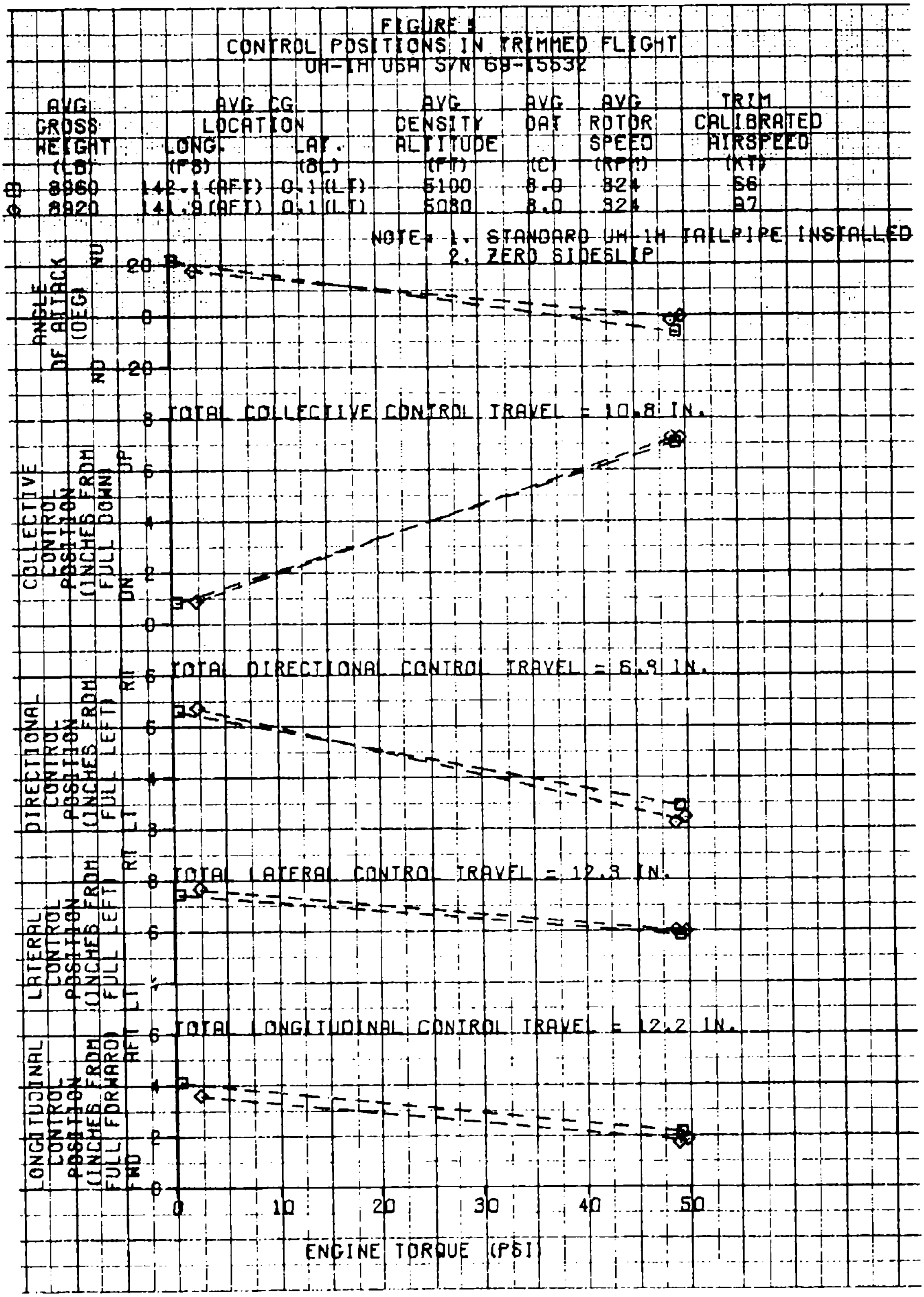


FIGURE 1
CONTROL POSITIONS IN TRIMMED FLIGHT
UH-1H USA S/N 69-15532
AVG GROSS WEIGHT (LB) 8740
AVG CG LOCATION LONG (FS) 132.4 (FWD)
LAT (BL) 0.0 (MID)
AVG DENSITY ALTITUDE (FEET) 5220
AVG OAT (C) 24.0
AVG ROTOR SPEED (RPM) 324
FLIGHT CONDITION LEVEL
NOTE: 1. INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED
2. ZERO SIDESLIP
ANGLE OF ATTACK (DEG)
TOTAL COLLECTIVE CONTROL TRAVEL = 10.8 IN.
COLLECTIVE CONTROL POSITION (INCHES FROM FULL DOWN)
TOTAL DIRECTIONAL CONTROL TRAVEL = 6.8 IN.
DIRECTIONAL CONTROL POSITION (INCHES FROM FULL LEFT)
TOTAL LATERAL CONTROL TRAVEL = 12.9 IN.
LATERAL CONTROL POSITION (INCHES FROM FULL LEFT)
TOTAL LONGITUDINAL CONTROL TRAVEL = 12.2 IN.
LONGITUDINAL CONTROL POSITION (INCHES FROM FULL FORWARD)
CALIBRATED AIRSPEED (KTS)

FIGURE 4
CONTROL POSITIONS IN TRIMMED FLIGHT
UH-1H USA S/N 69-15532





CONTROL POSITIONS IN TRIMMED FLIGHT
UH-1H USA S/N 69-15532
AVG GROSS WEIGHT (LB)
AVG CG LOCATION
LONG. (FS)
LAT. (BL)
AVG DENSITY ALTITUDE (FT)
AVG OAT (C)
AVG ROTOR SPEED (RPM)
TRIM CALIBRATED AIRSPEED (KT)
8960 142.1 (AFT) 0.1 (LT) 5100 8.0 324 56
8920 141.9 (AFT) 0.1 (LT) 5080 8.0 324 87
NOTE: 1. STANDARD UH-1H TAILPIPE INSTALLED
2. ZERO SIDESLIP
ANGLE OF ATTACK (DEG)
NU
ND
TOTAL COLLECTIVE CONTROL TRAVEL = 10.8 IN.
COLLECTIVE CONTROL POSITION (INCHES FROM FULL DOWN)
UP
DN
TOTAL DIRECTIONAL CONTROL TRAVEL = 6.9 IN.
DIRECTIONAL CONTROL POSITION (INCHES FROM FULL LEFT)
RT
LT
TOTAL LATERAL CONTROL TRAVEL = 12.3 IN.
LATERAL CONTROL POSITION (INCHES FROM FULL LEFT)
TOTAL LONGITUDINAL CONTROL TRAVEL = 12.2 IN.
LONGITUDINAL CONTROL POSITION (INCHES FROM FULL FORWARD)
AFT
FWD
ENGINE TORQUE (PSI)

FIGURE 6
CONTROL POSITIONS IN TRIMMED FLIGHT
UH-1H USA S/N 69-15532

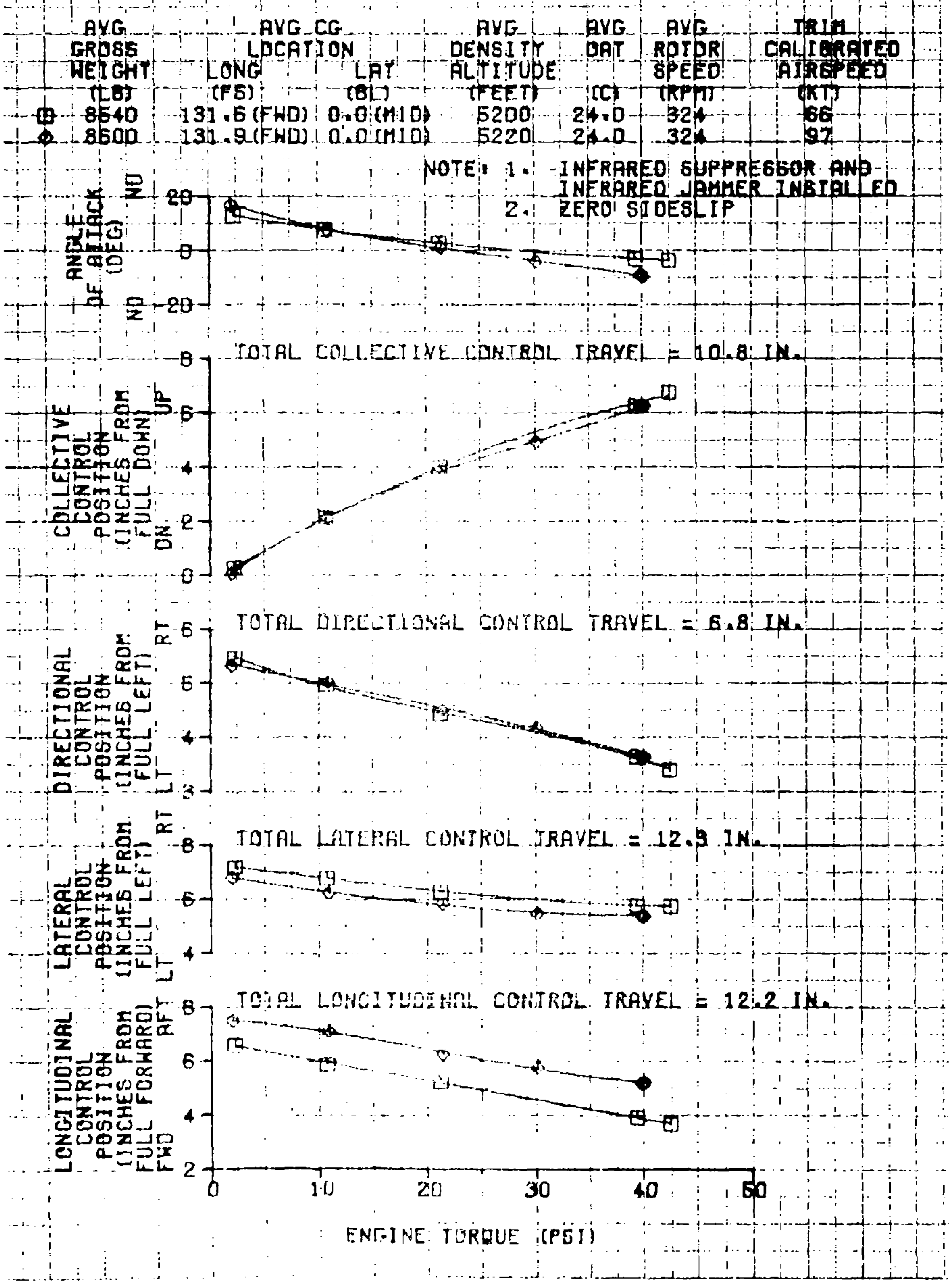


FIGURE 7
COLLECTIVE FIXED STATIC LONGITUDINAL STABILITY
UH-1H USA S/N 69-15532

	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
○	8980	142.2 (AFT)	0.1 (LT)	5360	6.5	324	LEVEL
□	8960	142.2 (AFT)	0.1 (LT)	5340	6.5	324	LEVEL

NOTE: 1. INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED
2. ZERO SIDESLIP
3. SHADED SYMBOLS DENOTE TRIM

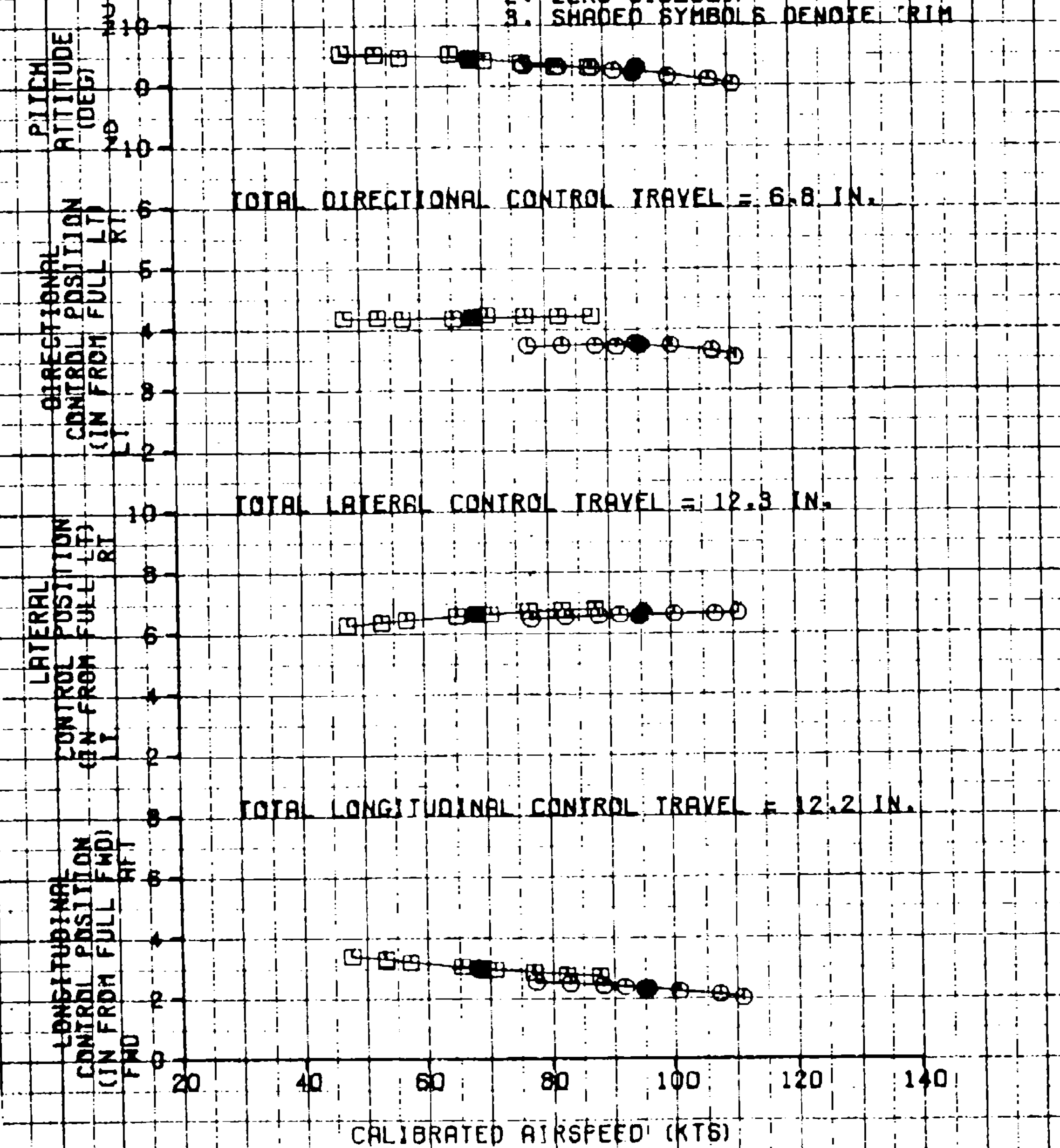


FIGURE [illegible]

COLLECTIVE FIXED STATIC LONGITUDINAL STABILITY

UH-1H USA S/N 69-15532

	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	LAT. (BL)	AVG DENSITY ALTITUDE (FEET)	AVG OAT	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
□	8950	142.0 (AFT)	0.1 (LT)	5260	9.0	324	LEVEL
○	8960	142.0 (AFT)	0.1 (LT)	5260	8.0	324	LEVEL

NOTE: 1. STANDARD UH-1H TAILPIPE INSTALLED
2. ZERO SIDESLIP
3. SHADED SYMBOLS DENOTE TRIM

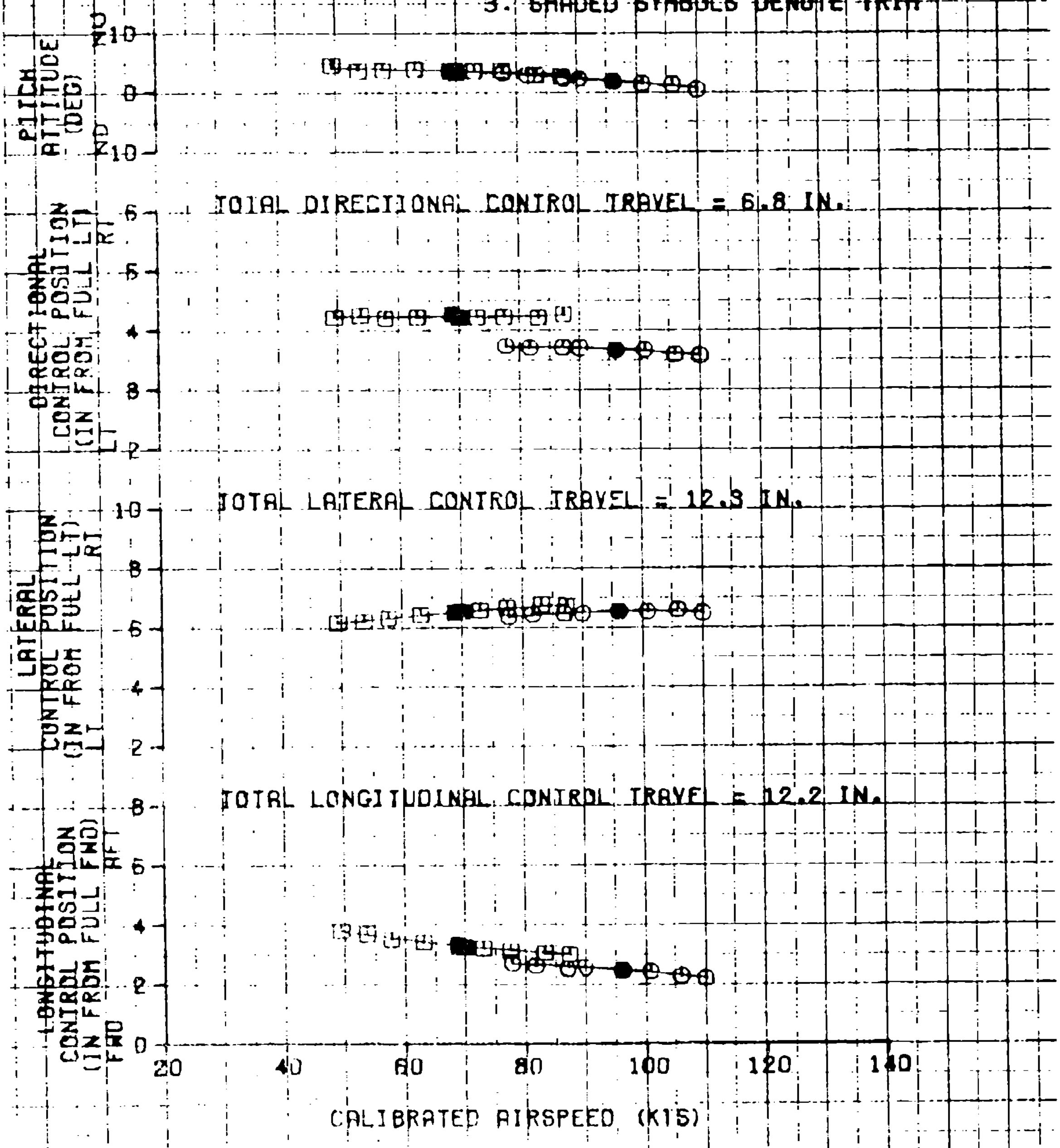


FIGURE 9
COLLECTIVE FIXED STATIC LONGITUDINAL STABILITY
UH-1H USA S/N 69-15532

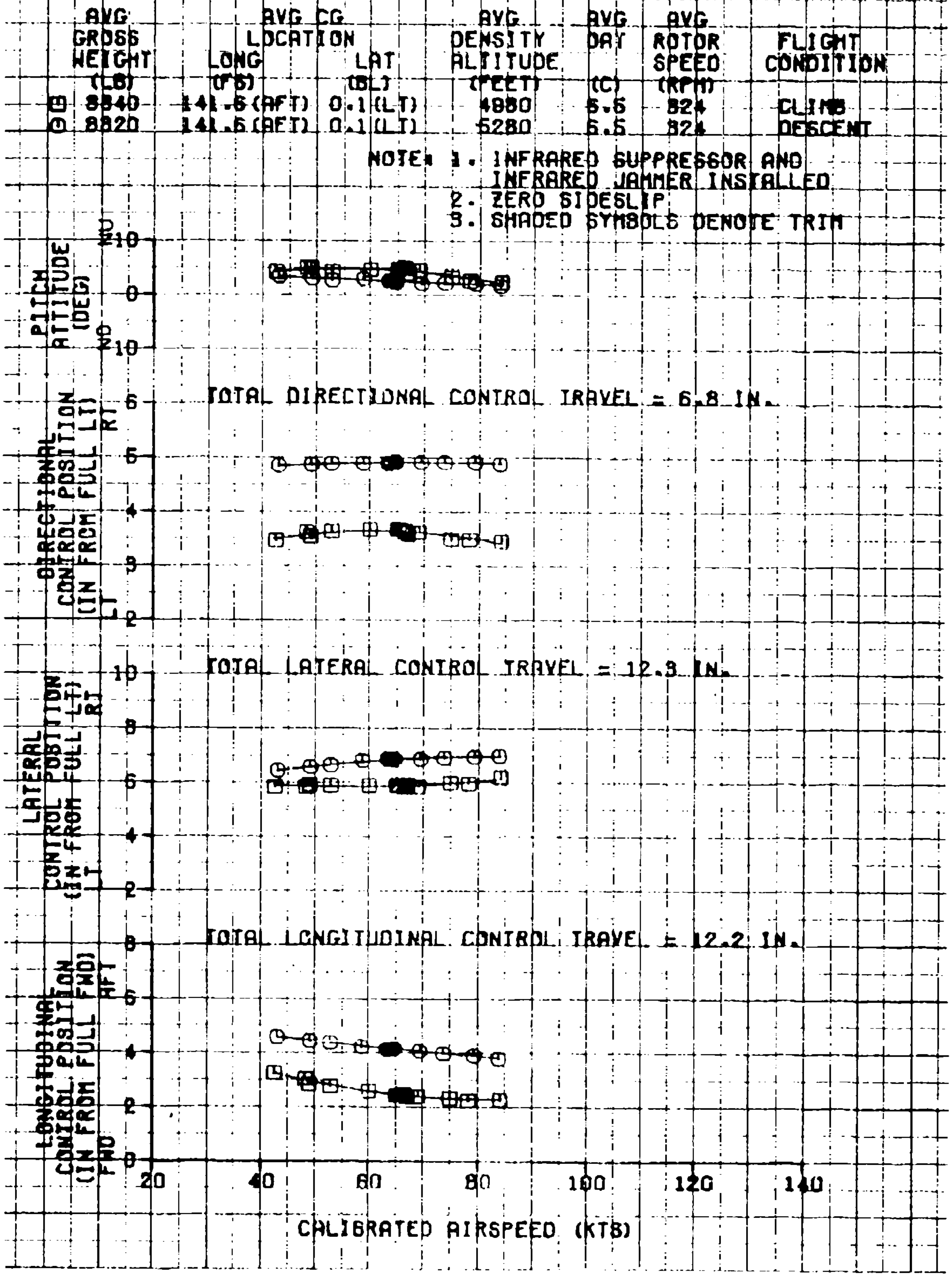
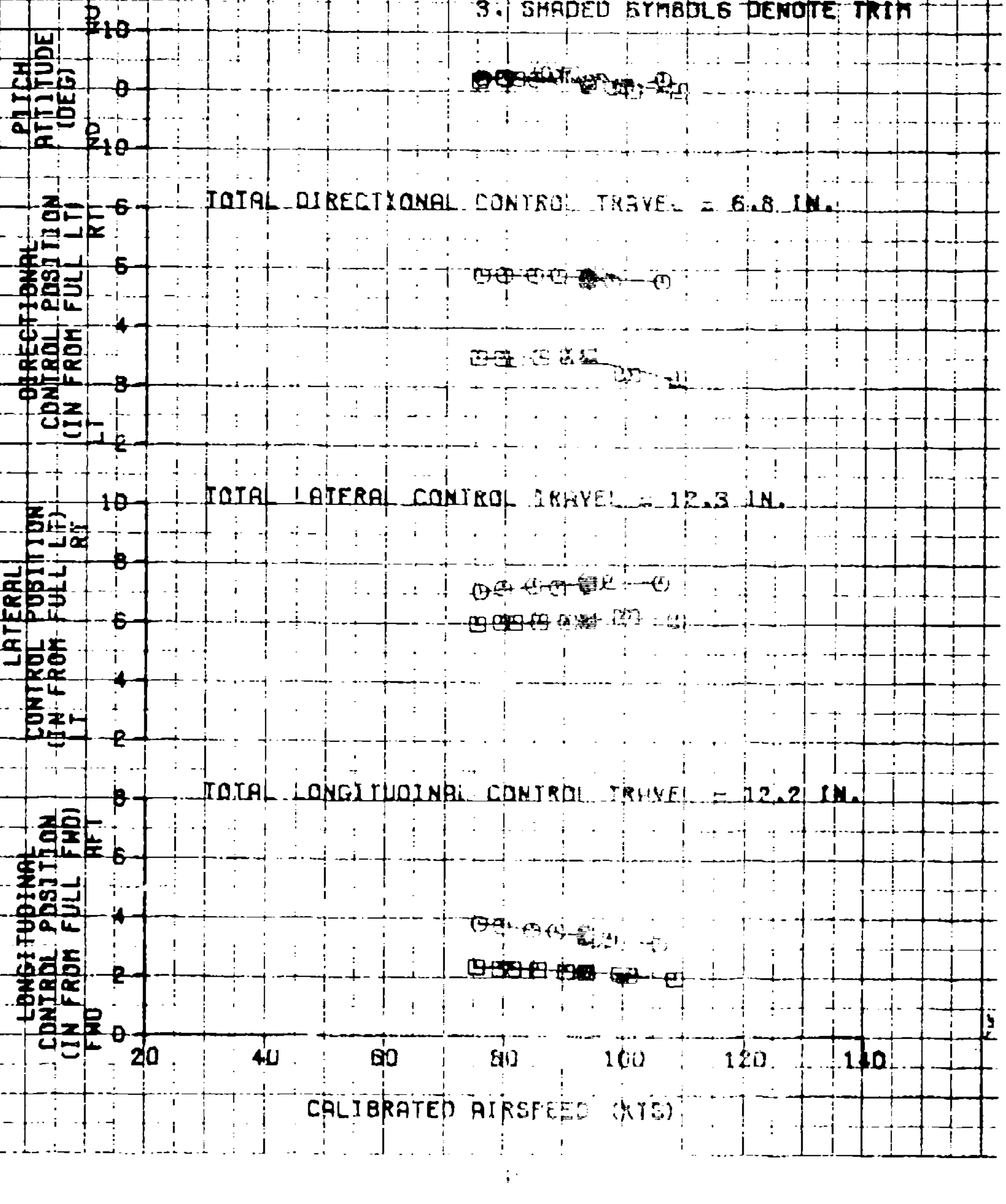


FIGURE 10
COLLECTIVE FIXED STATIC LONGITUDINAL STABILITY
UH-1H USA S/N 69-15532

SYMBOL	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
□	8840	141.6 (AFT)	0.1 (LT)	4980	5.5	324	CLIMB
○	8820	141.6 (AFT)	0.1 (LT)	5280	5.5	324	DESCENT

NOTE: 1. INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED
2. ZERO SIDESLIP
3. SHADED SYMBOLS DENOTE TRIM



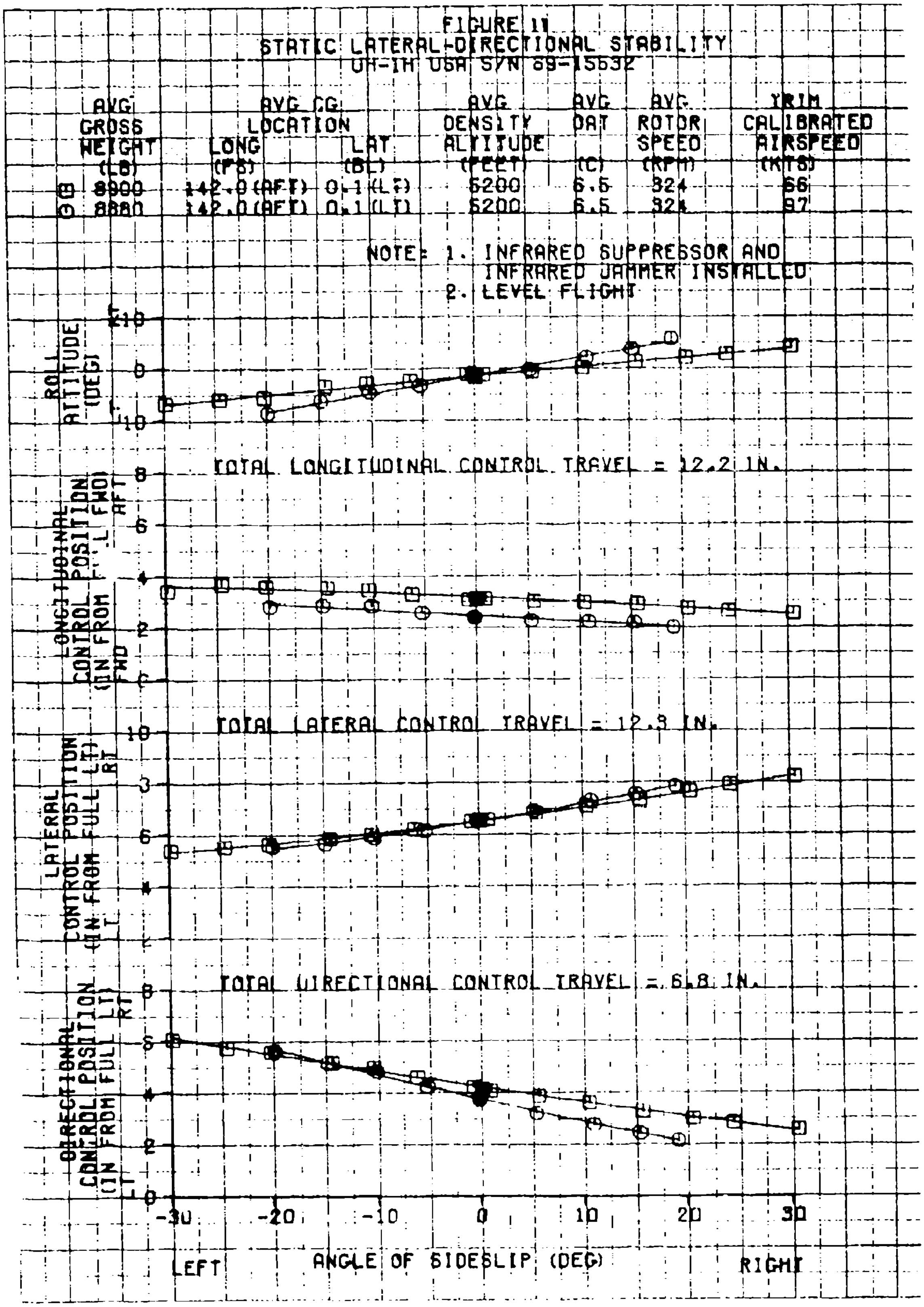


FIGURE 11
STATIC LATERAL-DIRECTIONAL STABILITY
UH-1H USA S/N 69-15532

FIGURE 11
STATIC LATERAL-DIRECTIONAL STABILITY
UH-1H USA S/N 69-15532

	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FEET)	AVG OAT	AVG ROTOR SPEED (RPM)	TRIM CALIBRATED AIRSPEED (KTS)
⊞	8960	141.7 (AFT)	0.1 (LT)	5140	9.0	824	56
⊖	8940	141.7 (AFT)	0.1 (LT)	5140	9.0	824	97

NOTE: 1. STANDARD UH-1H TAILPIPE INSTALLED
2. SHADED SYMBOLS DENOTE TRIM
3. LEVEL FLIGHT

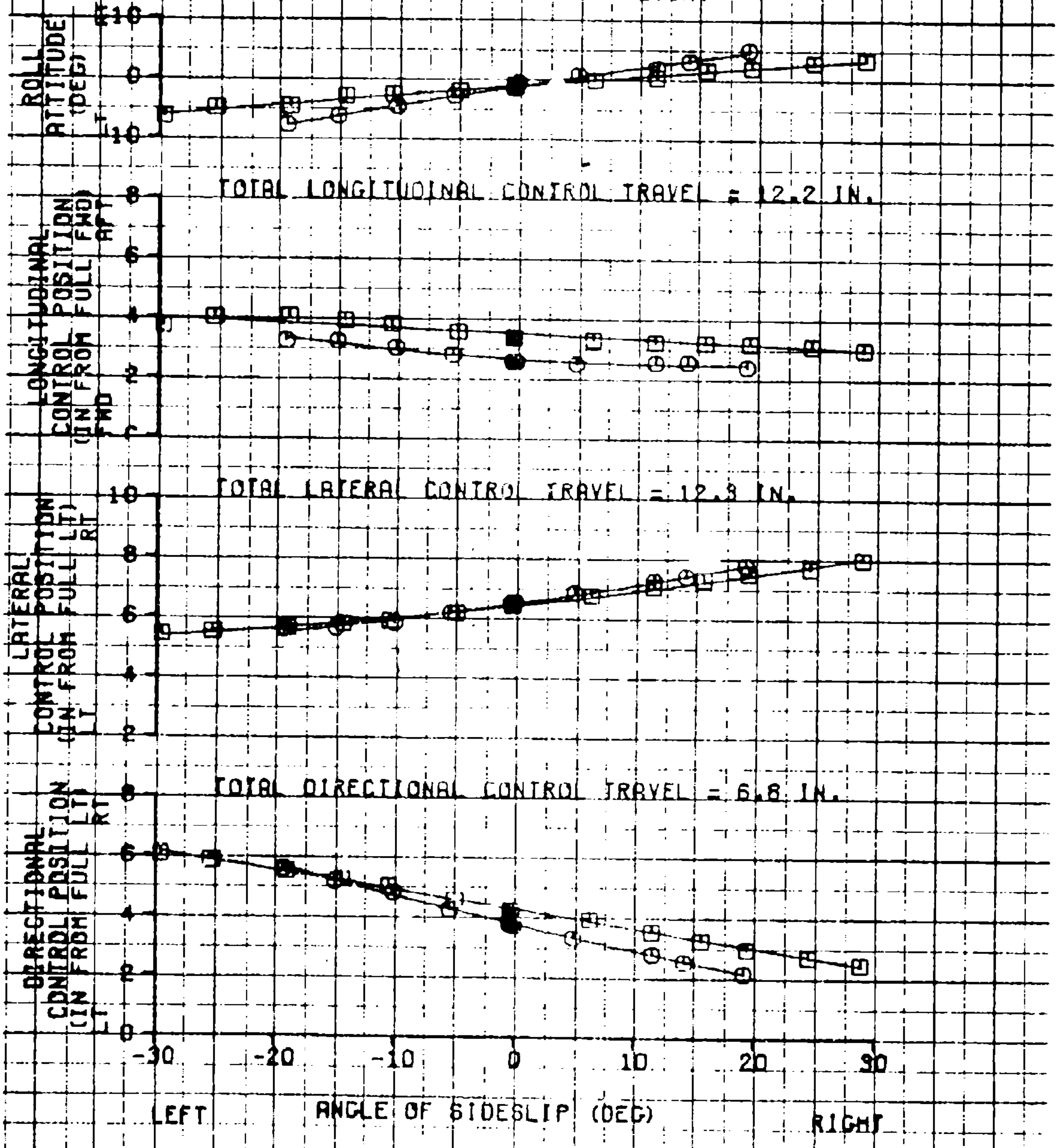


FIGURE 13
STATIC LATERAL-DIRECTIONAL STABILITY
UH-1H USA S/N 68-15532

SYMBOL	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
○	8800	141.6 (AFT)	0.1 (LT)	5360	7.0	324	CLIMB
□	8780	141.6 (AFT)	0.1 (LT)	4960	7.0	324	DESCENT

NOTE: 1. INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED
2. SHADED SYMBOLS DENOTE TRIM
3. TRIM CALIBRATED AIRSPEED 65 KTS

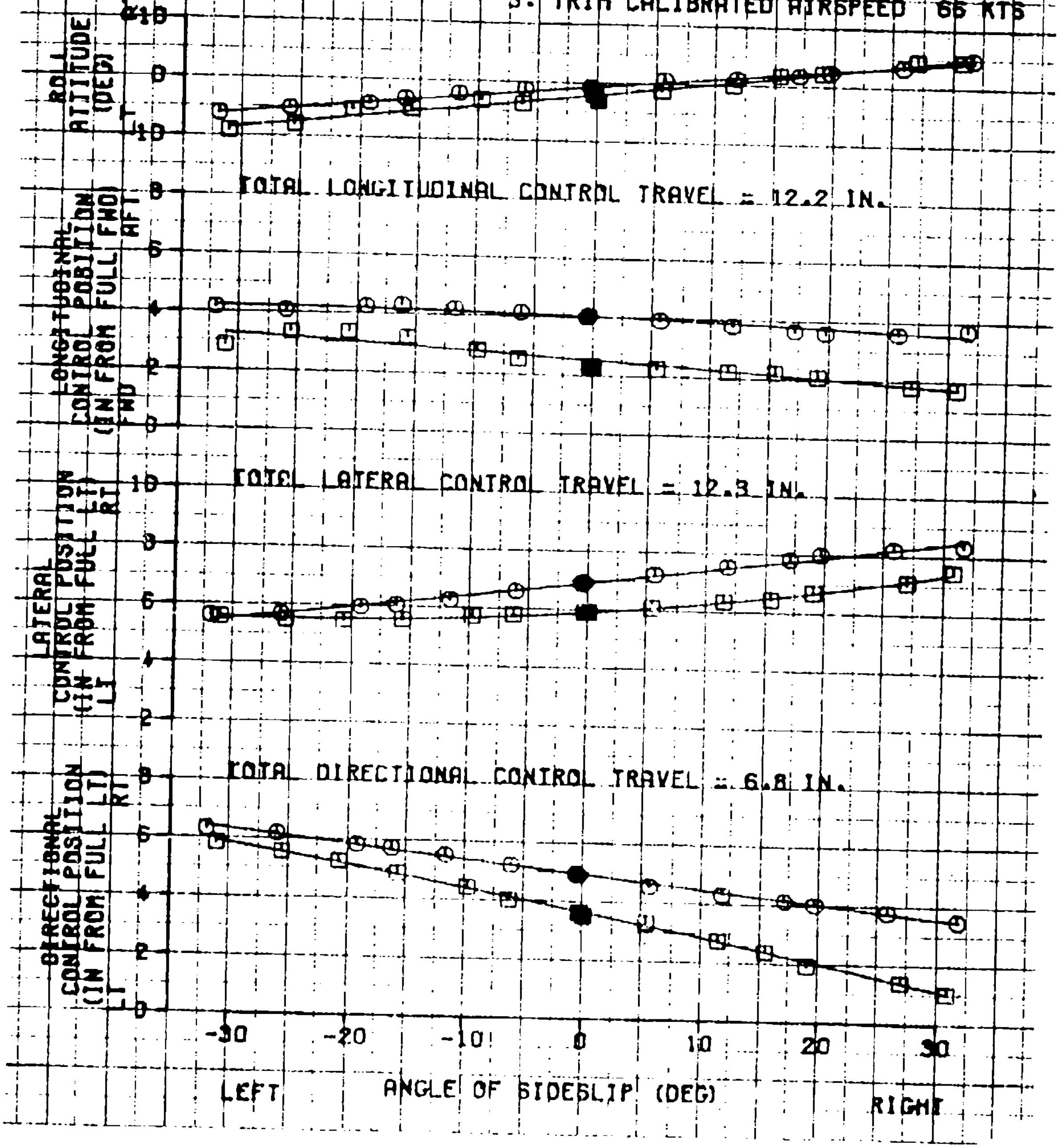


FIGURE 14
STATIC LATERAL-DIRECTIONAL STABILITY
OH-1H USA S/N 69-15532

	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FEET)	AVG OAT (C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
○	8800	141.6 (AFT)	0.1 (LT)	5360	7.0	324	CLIMB
□	8780	141.6 (AFT)	0.1 (LT)	4960	7.0	32	DESCENT

NOTE: 1. INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED
2. SHADED SYMBOLS DENOTE TRIM
3. TRIM CALIBRATED AIRSPEED 97 KTS

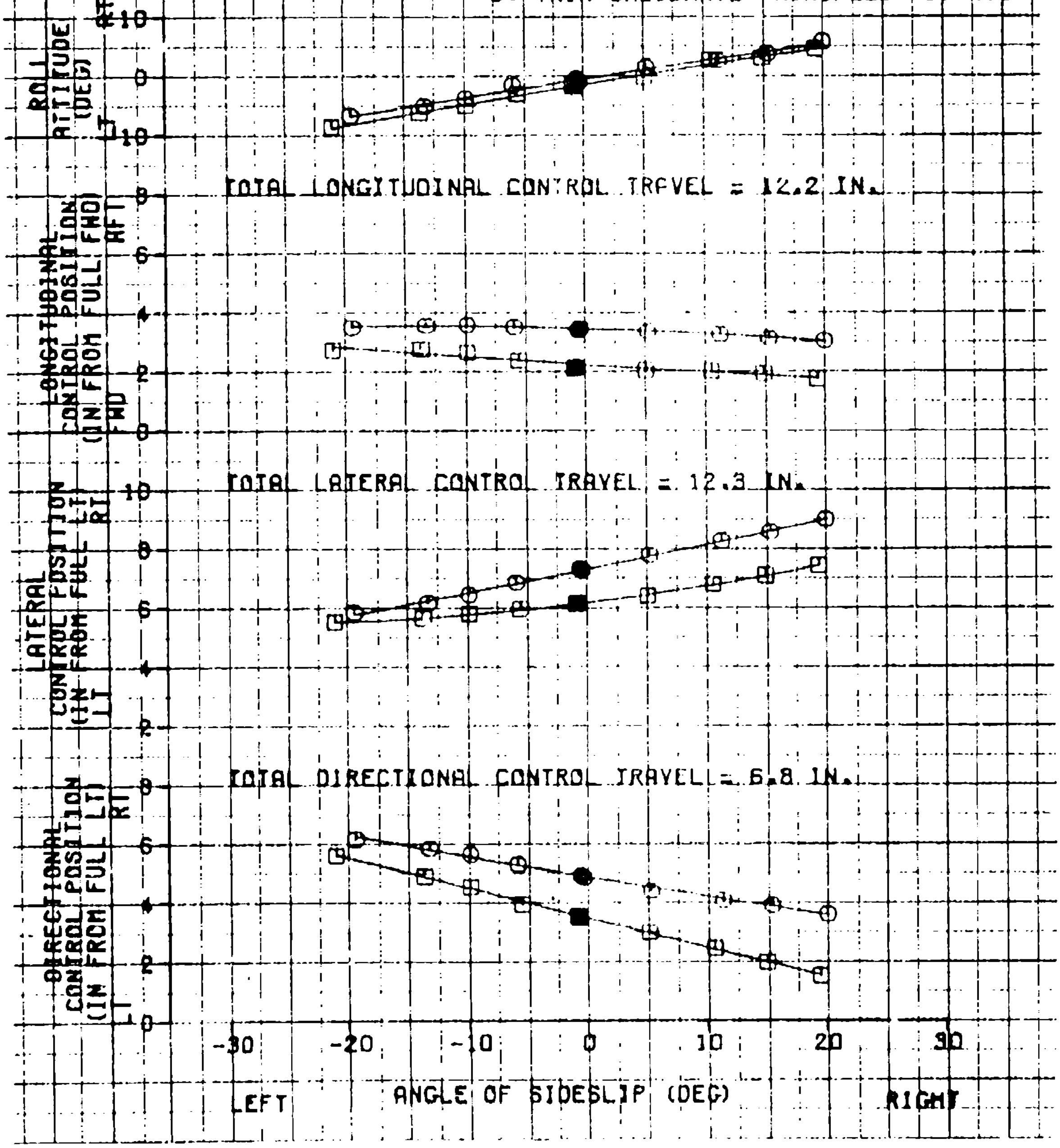


FIGURE 15
MANEUVERING STABILITY
UH-1H USA S/N 69-15532

	AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
○	8960	142.1 (AFT)	0.1(LT)	5960	7.5	324	67 KCAS LT TURN
□	8960	142.1 (AFT)	0.1(LT)	5940	7.5	324	67 KCAS RT TURN
◇	8940	142.0 (AFT)	0.1(LT)	5920	7.5	324	97 KCAS LT TURN
○	8940	142.0 (AFT)	0.1(LT)	5940	7.5	324	97 KCAS RT TURN

NOTE: INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED

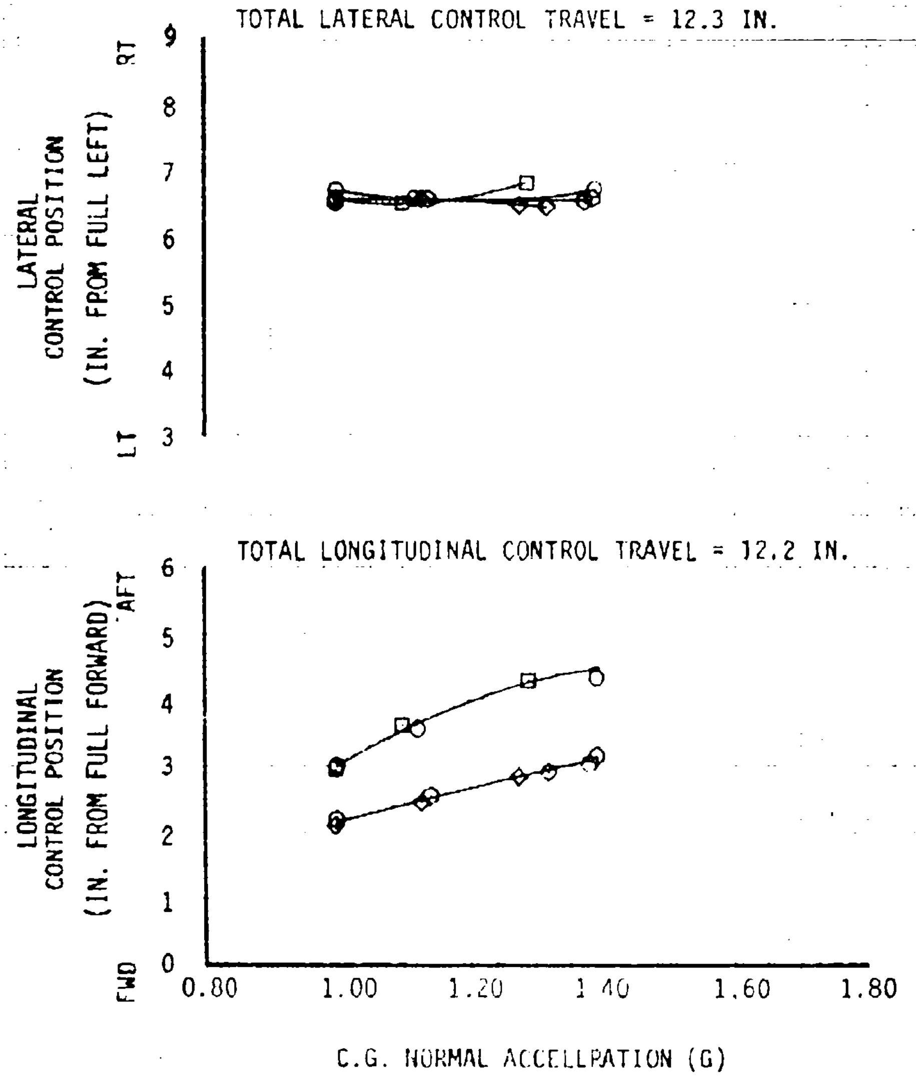
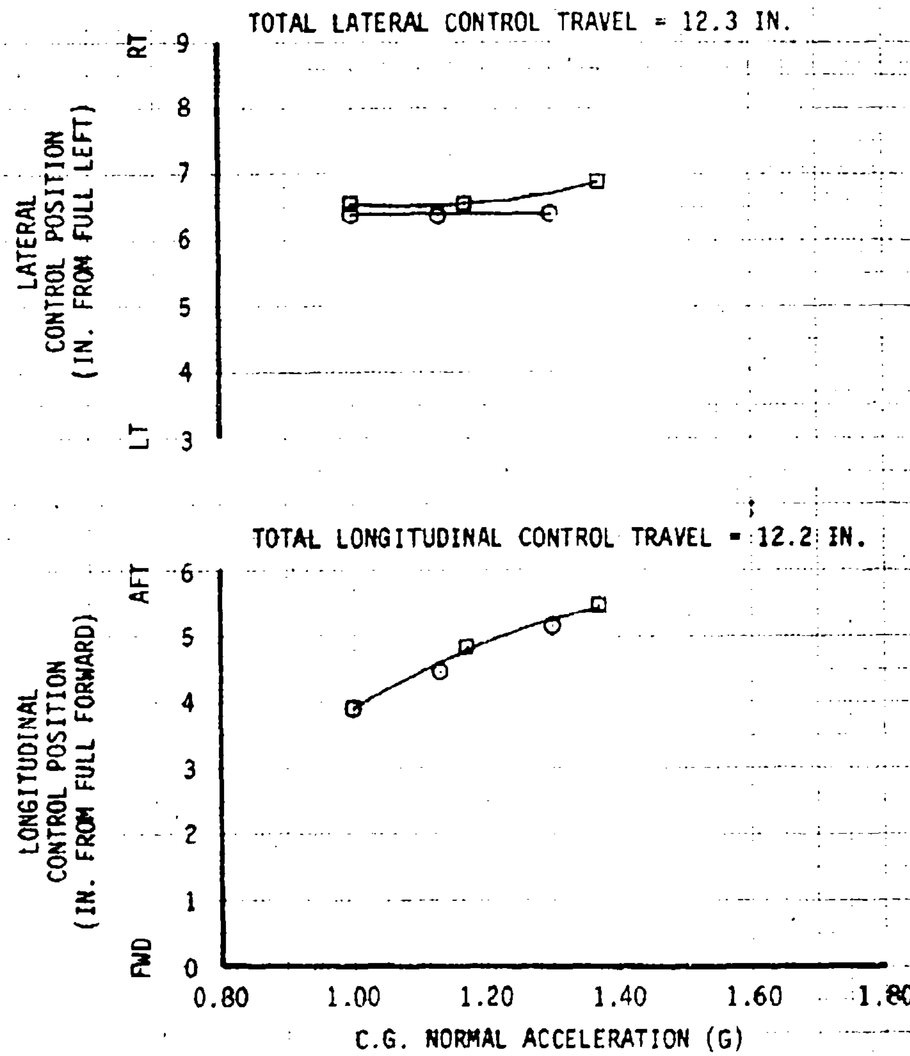


FIGURE 16
MANEUVERING STABILITY
UH-1H USA S/N 69-15532

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)	FLIGHT CONDITION
○ 8680	141.1 (AFT)	0.1 (LT)	6260	6.0	324	66 KCAS LEFT TURN
□ 8680	141.1 (AFT)	0.1 (LT)	6380	6.0	324	66 KCAS RIGHT TURN

NOTE: STANDARD UH-1H TAILPIPE INSTALLED.



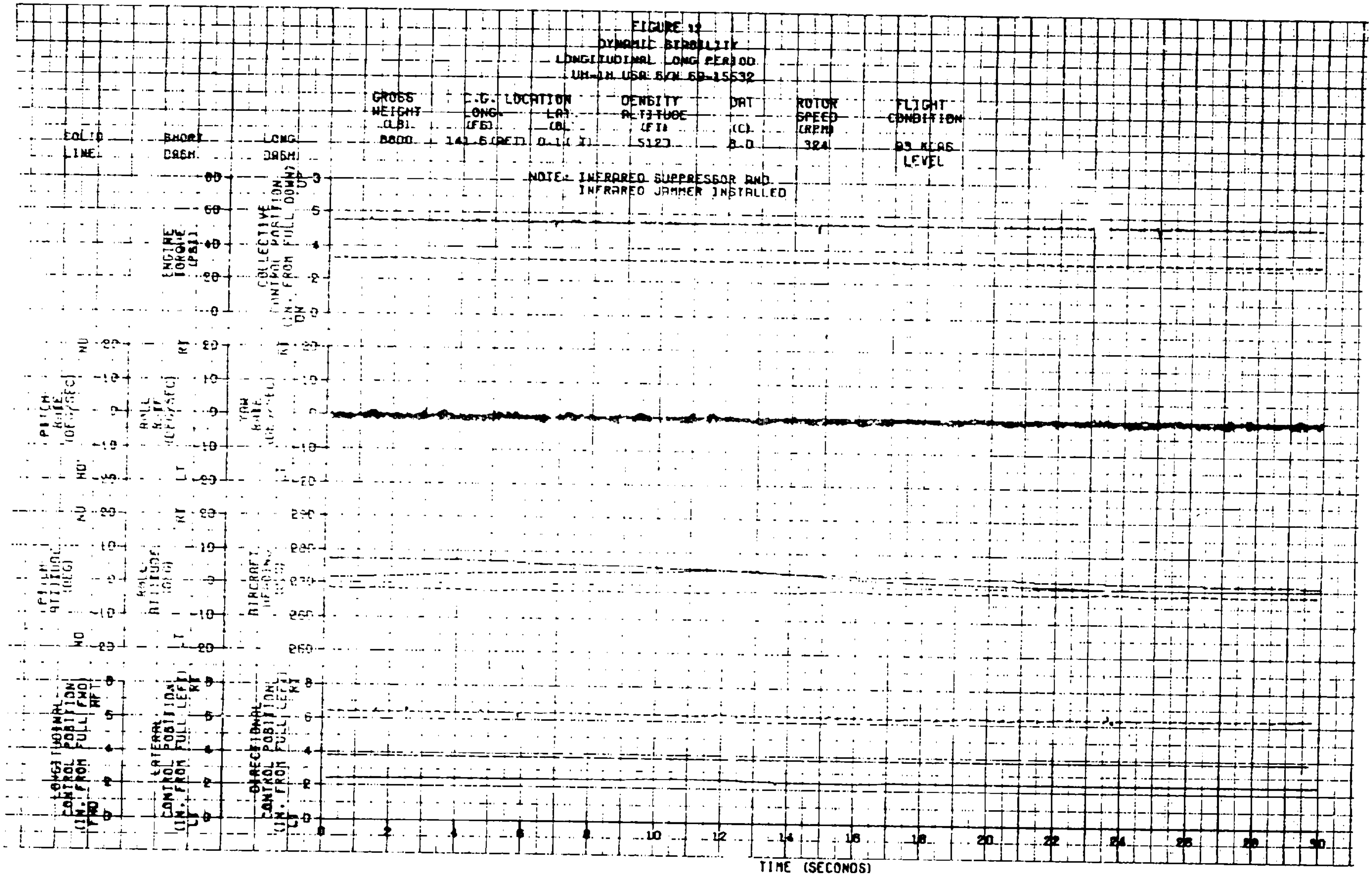


FIGURE 12
DYNAMIC STABILITY
LONGITUDINAL LONG PERIOD
UH-1H USA S/N 68-15532
GROSS WEIGHT (LB) 8800
C.G. LOCATION LONG. (FS) 141.6 (AFT)
LAT. (BL) 0.1 (LT)
DENSITY ALTITUDE (FT) 5120
OAT (C) 8.0
ROTOR SPEED (RPM) 324
FLIGHT CONDITION 93 KCAS LEVEL
SOLID LINE
SHORT DASH
LONG DASH
NOTE: INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED
ENGINE TORQUE (PSI)
COLLECTIVE CONTROL POSITION (IN. FROM FULL DOWN)
PITCH RATE (DEG/SEC)
ROLL RATE (DEG/SEC)
YAW RATE (DEG/SEC)
PITCH ATTITUDE (DEG)
ROLL ATTITUDE (DEG)
AIRCRAFT HEADING (DEG)
LONGITUDINAL CONTROL POSITION (IN. FROM FULL FWD)
LATERAL CONTROL POSITION (IN. FROM FULL LEFT)
DIRECTIONAL CONTROL POSITION (IN. FROM FULL LEFT)
TIME (SECONDS)

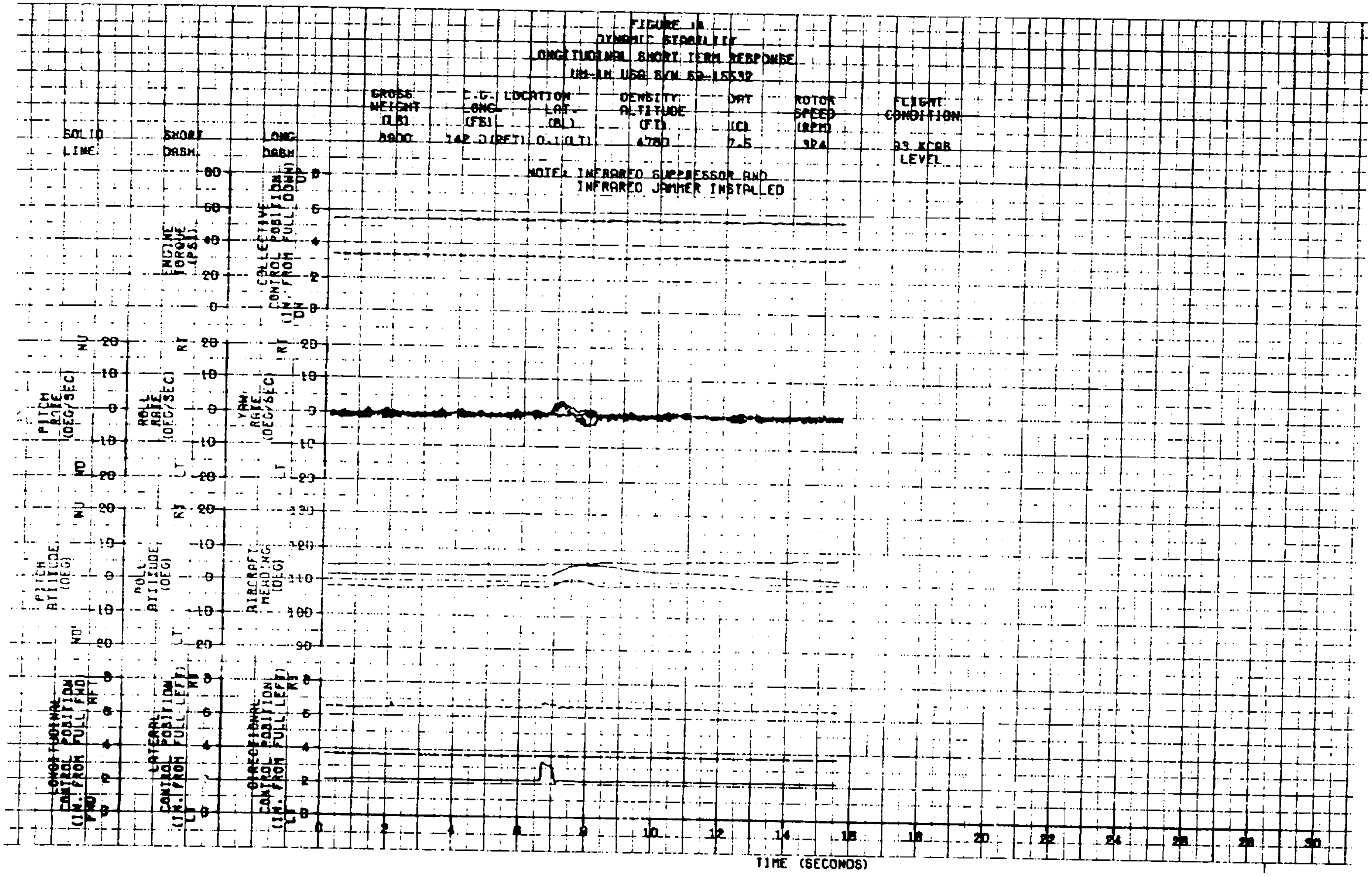
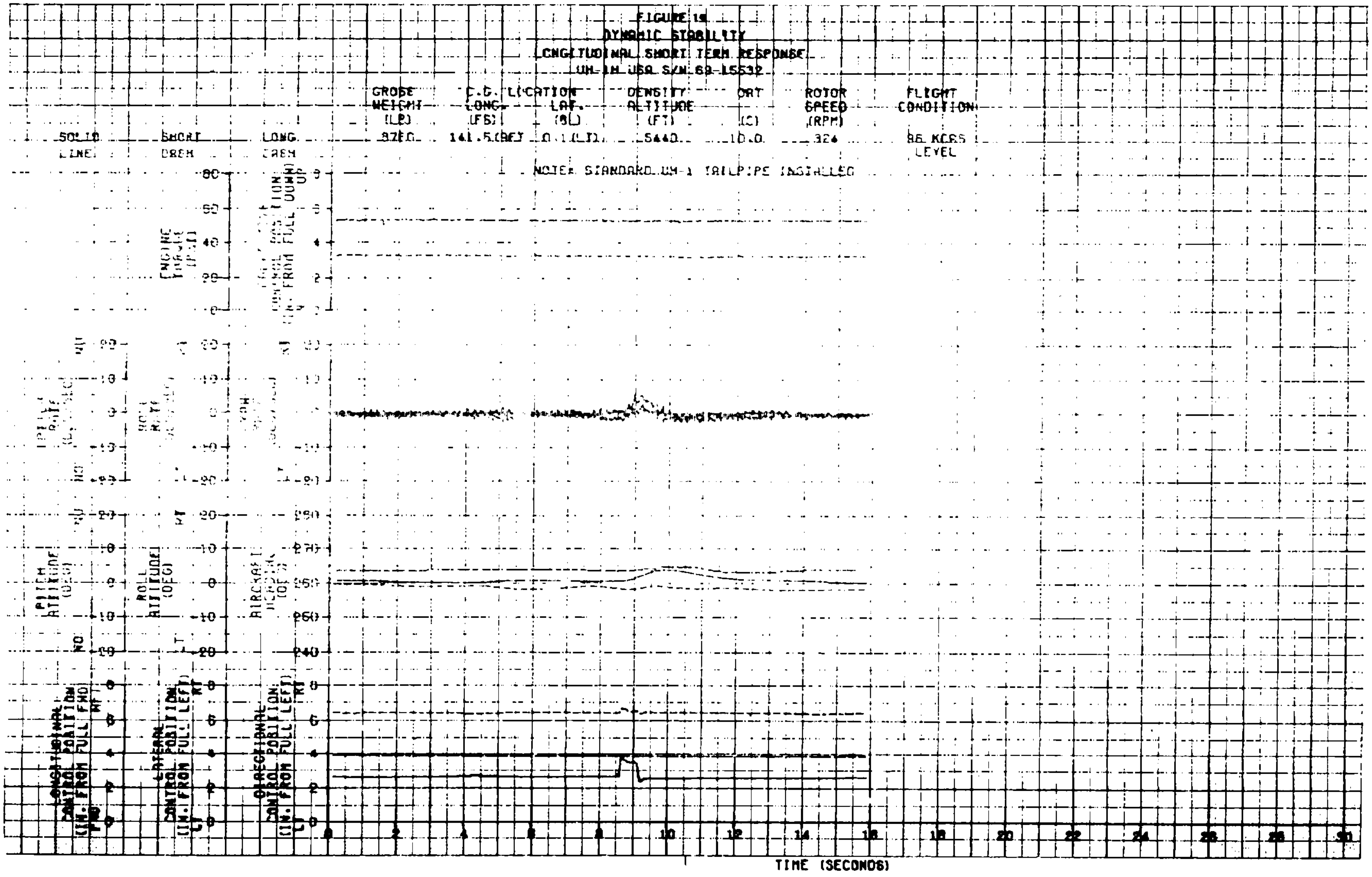


FIGURE 18
DYNAMIC STABILITY
LONGITUDINAL SHORT TERM RESPONSE
UH-1M USA S/N 65-15532
GROSS WEIGHT (LB) 8800
C.G. LOCATION LONG. (FS) 142.0(AFT)
LAT. (BL) 0.1(LT)
DENSITY ALTITUDE (FT) 4780
OAT (C) 7.5
ROTOR SPEED (RPM) 324
FLIGHT CONDITION 93 KCAS LEVEL
NOTE: INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED
SOLID LINE
SHORT DASH
LONG DASH
ENGINE TORQUE (PSI)
COLLECTIVE CONTROL POSITION (IN. FROM FULL DOWN)
PITCH RATE (DEG/SEC)
ROLL RATE (DEG/SEC)
YAW RATE (DEG/SEC)
PITCH ATTITUDE (DEG)
ROLL ATTITUDE (DEG)
AIRCRAFT HEADING (DEG)
LONGITUDINAL CONTROL POSITION (IN. FROM FULL FWD)
LATERAL CONTROL POSITION (IN. FROM FULL LEFT)
DIRECTIONAL CONTROL POSITION (IN. FROM FULL LEFT)
TIME (SECONDS)



DYNAMIC STABILITY
LONGITUDINAL SHORT TERM RESPONSE
UH-1H USA S/N 69-15532
GROSS WEIGHT (LB)
C.G. LOCATION
LONG. (FS)
LAT. (BL)
DENSITY ALTITUDE (FT)
OAT (C)
ROTOR SPEED (RPM)
FLIGHT CONDITION
SOLID LINE
SHORT DASH
LONG DASH
8760
141.5(AFT)
0.1(LT)
5440
10.0
324
86 KCAS LEVEL
NOTE: STANDARD UH-1 TAILPIPE INSTALLED
ENGINE TORQUE (PSI)
PITCH RATE
ROLL RATE
YAW RATE
PITCH ATTITUDE (DEG)
ROLL ATTITUDE (DEG)
AIRCRAFT HEADING (DEG)
LONGITUDINAL CONTROL POSITION (IN. FROM FULL FWD)
LATERAL CONTROL POSITION (IN. FROM FULL LEFT)
DIRECTIONAL CONTROL POSITION (IN. FROM FULL LEFT)
TIME (SECONDS)

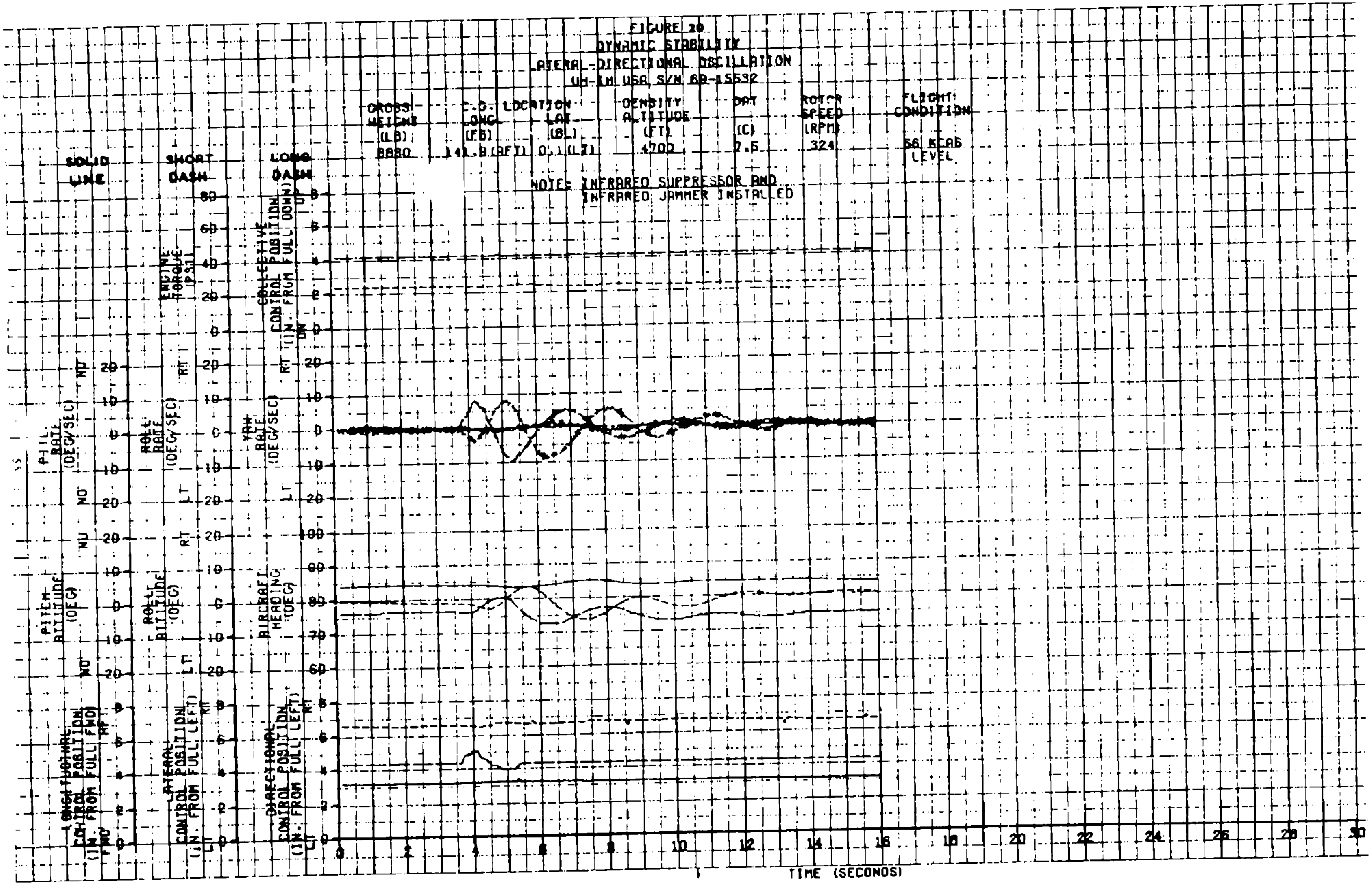


FIGURE 20
DYNAMIC STABILITY
LATERAL-DIRECTIONAL OSCILLATION
UH-1M USA S/N 68-15532
GROSS WEIGHT (LB) 8880
C.G. LOCATION LONG (FS) 141.8 (AFT)
LAT (BL) 0.1 (LT)
DENSITY ALTITUDE (FT) 4700
OAT (C) 7.5
ROTOR SPEED (RPM) 324
FLIGHT CONDITION 56 KCAS LEVEL
NOTES: INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED
SOLID LINE
SHORT DASH
LONG DASH
PITCH RATE (DEG/SEC)
ROLL RATE (DEG/SEC)
YAW RATE (DEG/SEC)
PITCH ATTITUDE (DEG)
ROLL ATTITUDE (DEG)
AIRCRAFT HEADING (DEG)
ENGINE TORQUE (PSI)
COLLECTIVE CONTROL POSITION (IN. FROM FULL DOWN)
LONGITUDINAL CONTROL POSITION (IN. FROM FULL FWD)
LATERAL CONTROL POSITION (IN. FROM FULL LEFT)
DIRECTIONAL CONTROL POSITION (IN. FROM FULL LEFT)
TIME (SECONDS)

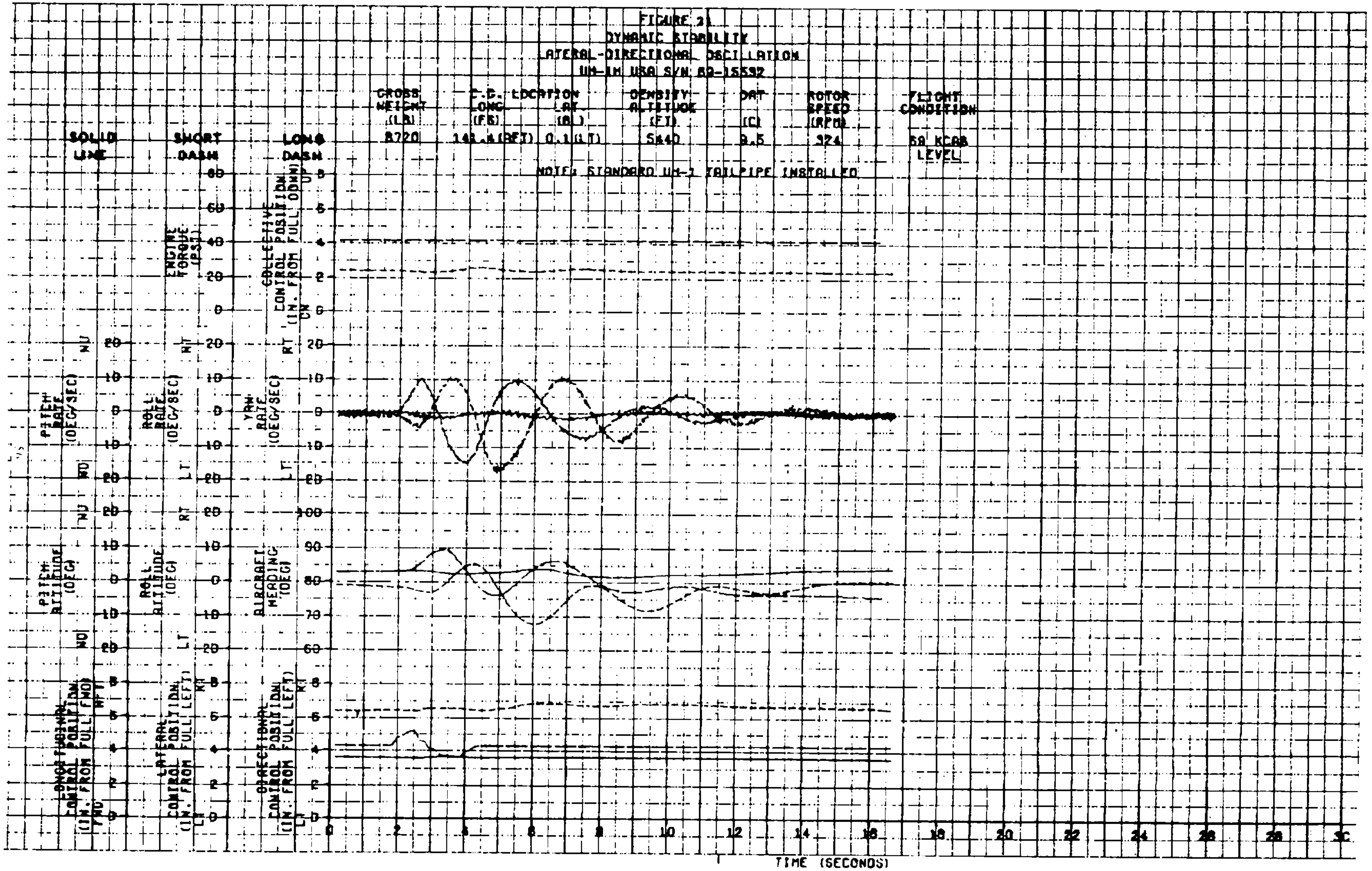


FIGURE 3
DYNAMIC STABILITY
LATERAL-DIRECTIONAL OSCILLATION
UH-1H USA S/N 60-15592
GROSS WEIGHT (LB)
8720
C.G. LOCATION
LONG (FS)
142.4 (AFT)
LAT (BL)
0.1 (LT)
DENSITY ALTITUDE (FT)
5440
OAT (C)
9.5
ROTOR SPEED (RPM)
324
FLIGHT CONDITION
59 KCAS
LEVEL
NOTE: STANDARD UH-1 TAILPIPE INSTALLED
SOLID LINE
SHORT DASH
LONG DASH
PITCH RATE (DEG/SEC)
ROLL RATE (DEG/SEC)
YAW RATE (DEG/SEC)
ENGINE TORQUE (PSI)
COLLECTIVE CONTROL POSITION (IN. FROM FULL DOWN)
PITCH ATTITUDE (DEG)
ROLL ATTITUDE (DEG)
AIRCRAFT HEADING (DEG)
LONGITUDINAL CONTROL POSITION (IN. FROM FULL FWD)
LATERAL CONTROL POSITION (IN. FROM FULL LEFT)
DIRECTIONAL CONTROL POSITION (IN. FROM FULL LEFT)
NU
ND
RT
LT
UP
DN
AFT
FWD
RT
LT
TIME (SECONDS)

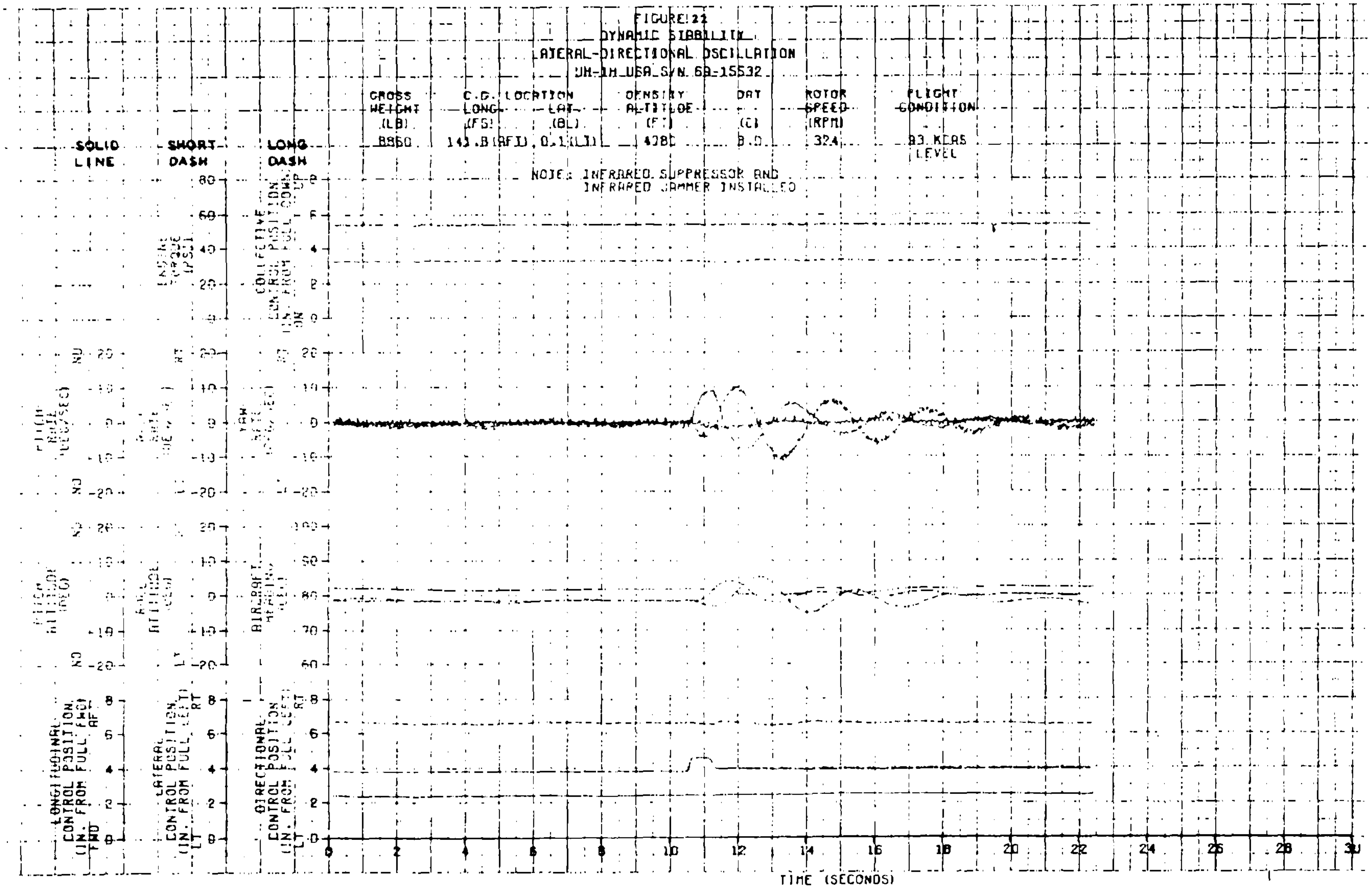


FIGURE 22
DYNAMIC STABILITY
LATERAL-DIRECTIONAL OSCILLATION
UH-1H USA S/N 69-15532

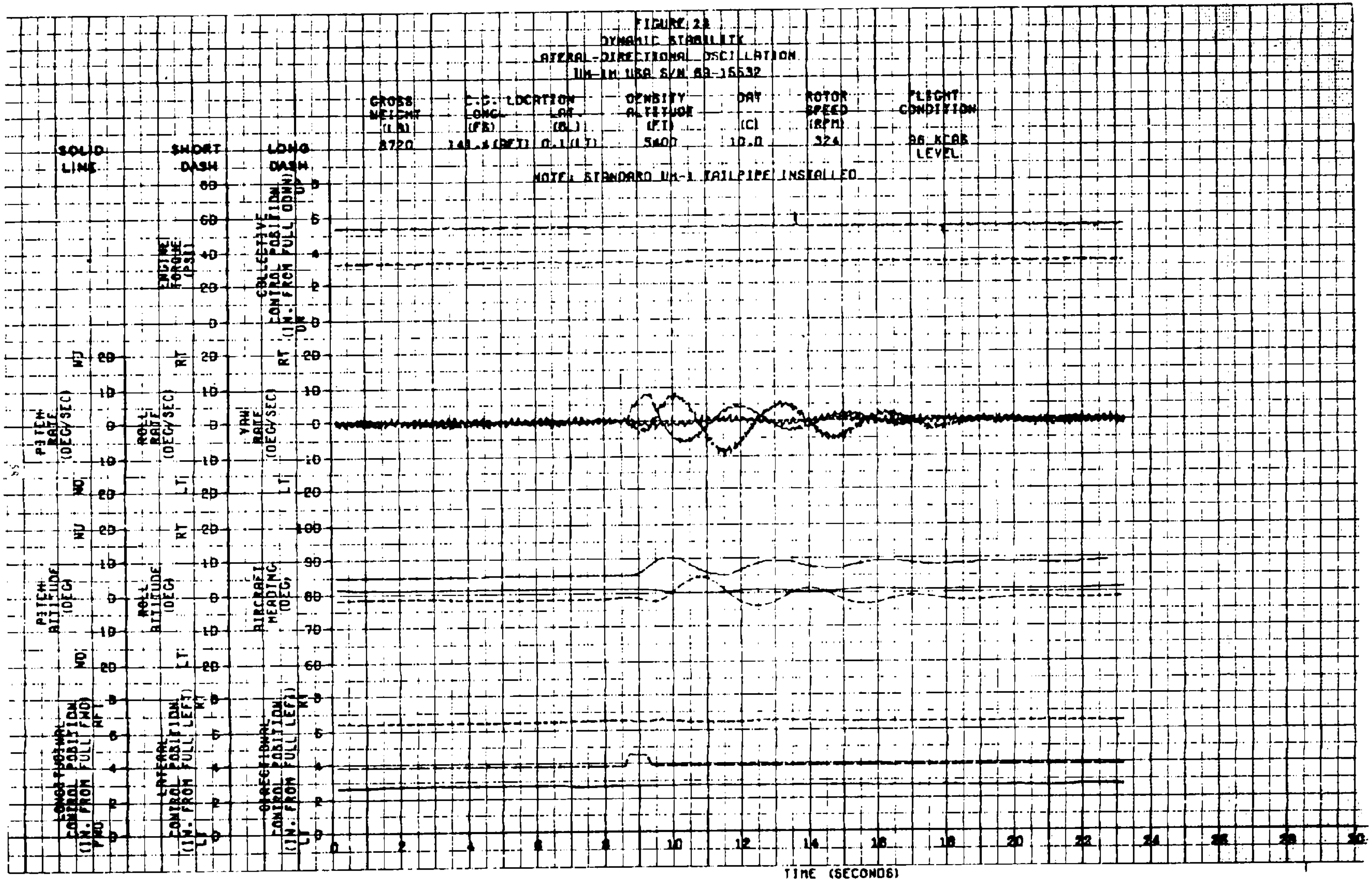
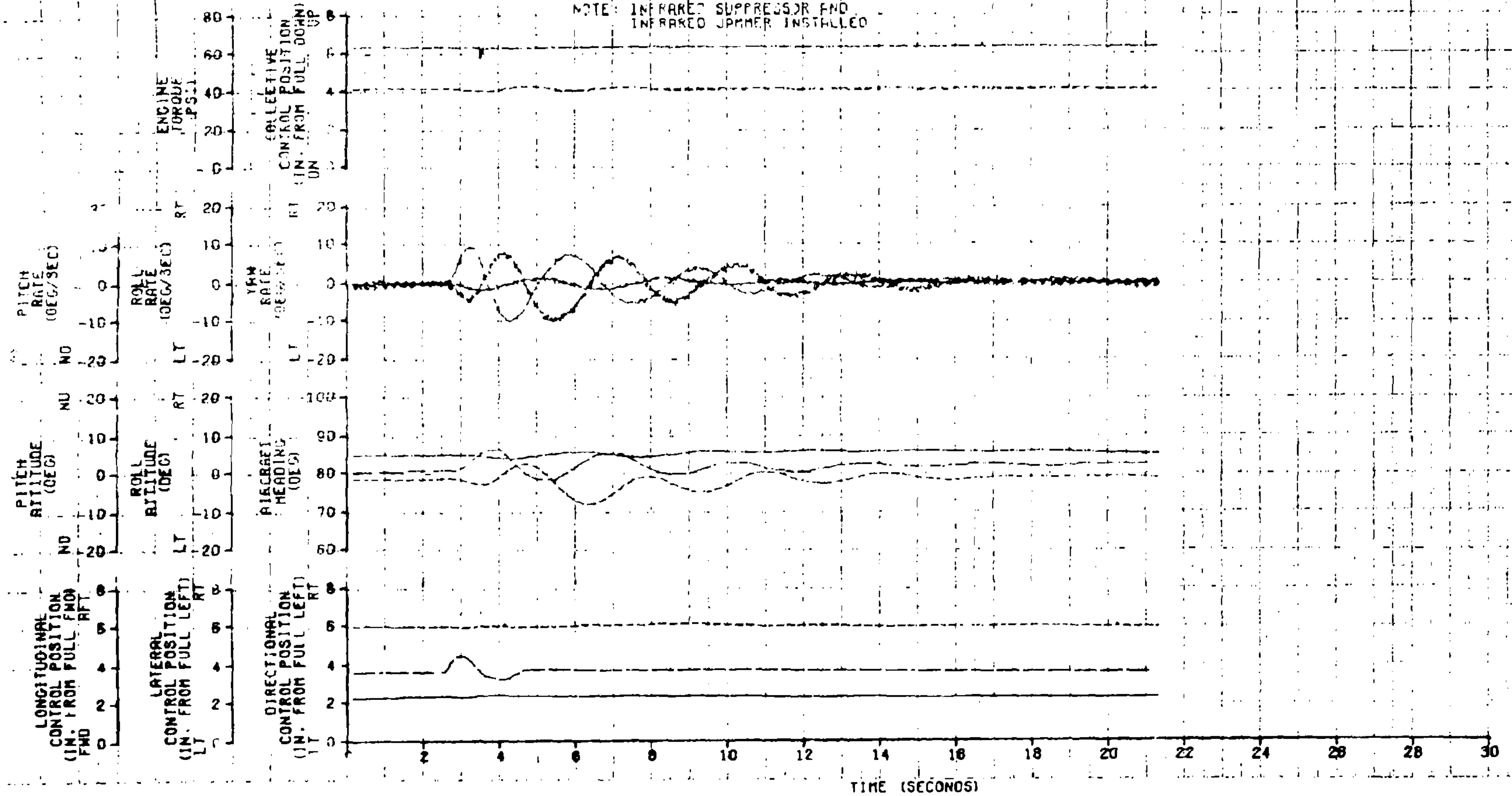


FIGURE 23
DYNAMIC STABILITY
LATERAL-DIRECTIONAL OSCILLATION
UH-1M USA S/N 63-15532
GROSS WEIGHT (LB) 8720
C.G. LOCATION LONG. (FS) 141.4(AFT) LAT. (BL) 0.1(LT)
DENSITY ALTITUDE (FT) 5400
OAT (C) 10.0
ROTOR SPEED (RPM) 324
FLIGHT CONDITION 96 KCAS LEVEL
NOTE: STANDARD UH-1 TAILPIPE INSTALLED
SOLID LINE
SHORT DASH
LONG DASH
PITCH RATE (DEG/SEC)
ROLL RATE (DEG/SEC)
YAW RATE (DEG/SEC)
ENGINE TORQUE (PSI)
COLLECTIVE CONTROL POSITION (IN. FROM FULL DOWN)
PITCH ATTITUDE (DEG)
ROLL ATTITUDE (DEG)
AIRCRAFT HEADING (DEG)
LONGITUDINAL CONTROL POSITION (IN. FROM FULL FWD)
LATERAL CONTROL POSITION (IN. FROM FULL LEFT)
DIRECTIONAL CONTROL POSITION (IN. FROM FULL LEFT)
TIME (SECONDS)

FIGURE 24
DYNAMIC STABILITY
LATERAL-DIRECTIONAL OSCILLATION
UH-1H USA S/N 69-15532

GROSS WEIGHT (LB)	C.G. LOCATION LONG. (FS)	C.G. LOCATION LAT. (BL)	DENSITY ALTITUDE (FT)	OAT (C)	ROTOR SPEED (RPM)	FLIGHT CONDITION
8840	141.8 (AFT)	0.1 (LT)	4740	8.0	324	65 KCAS CLIMB

NOTE: INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED



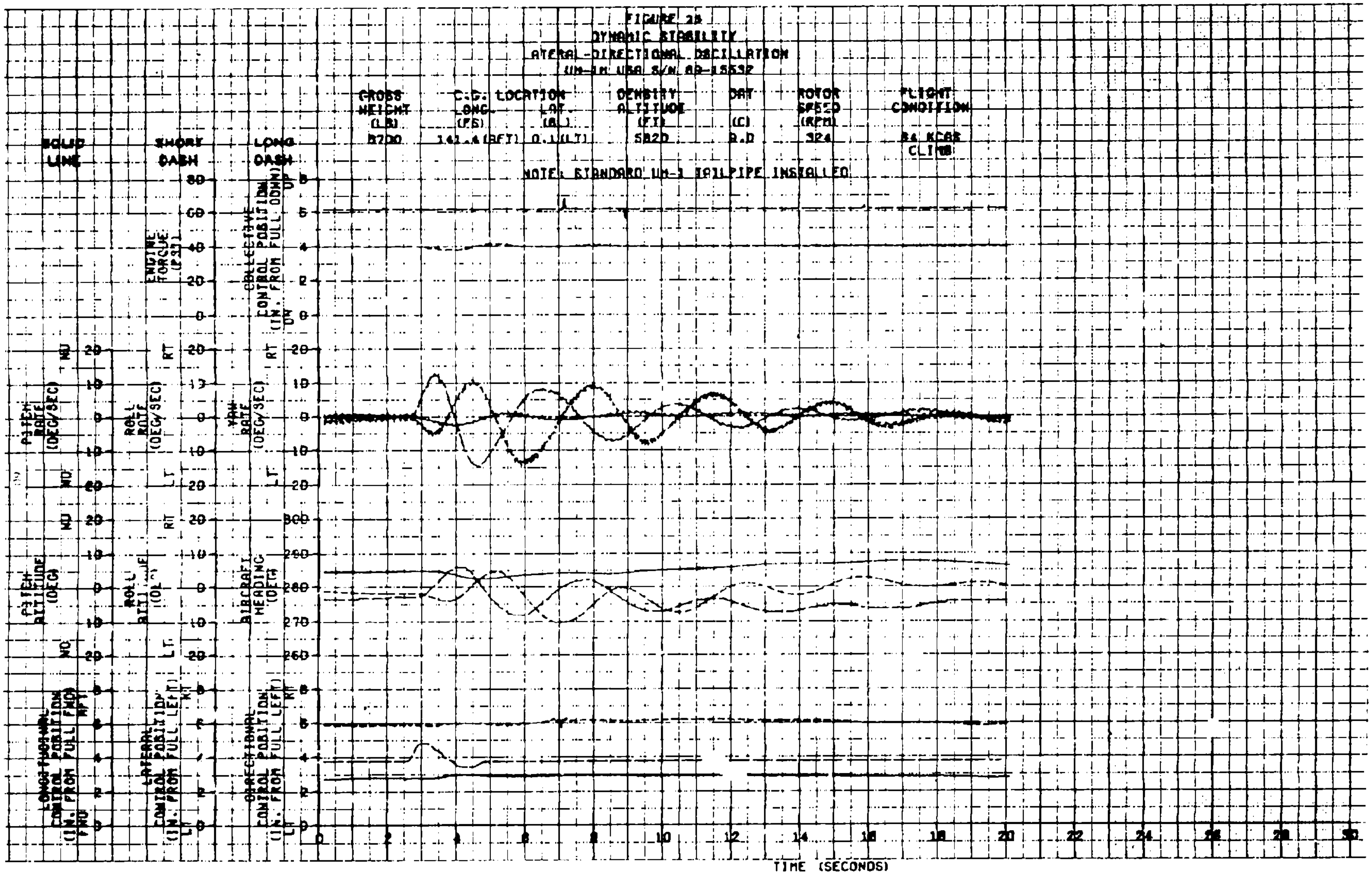


FIGURE 28
DYNAMIC STABILITY
LATERAL-DIRECTIONAL OSCILLATION

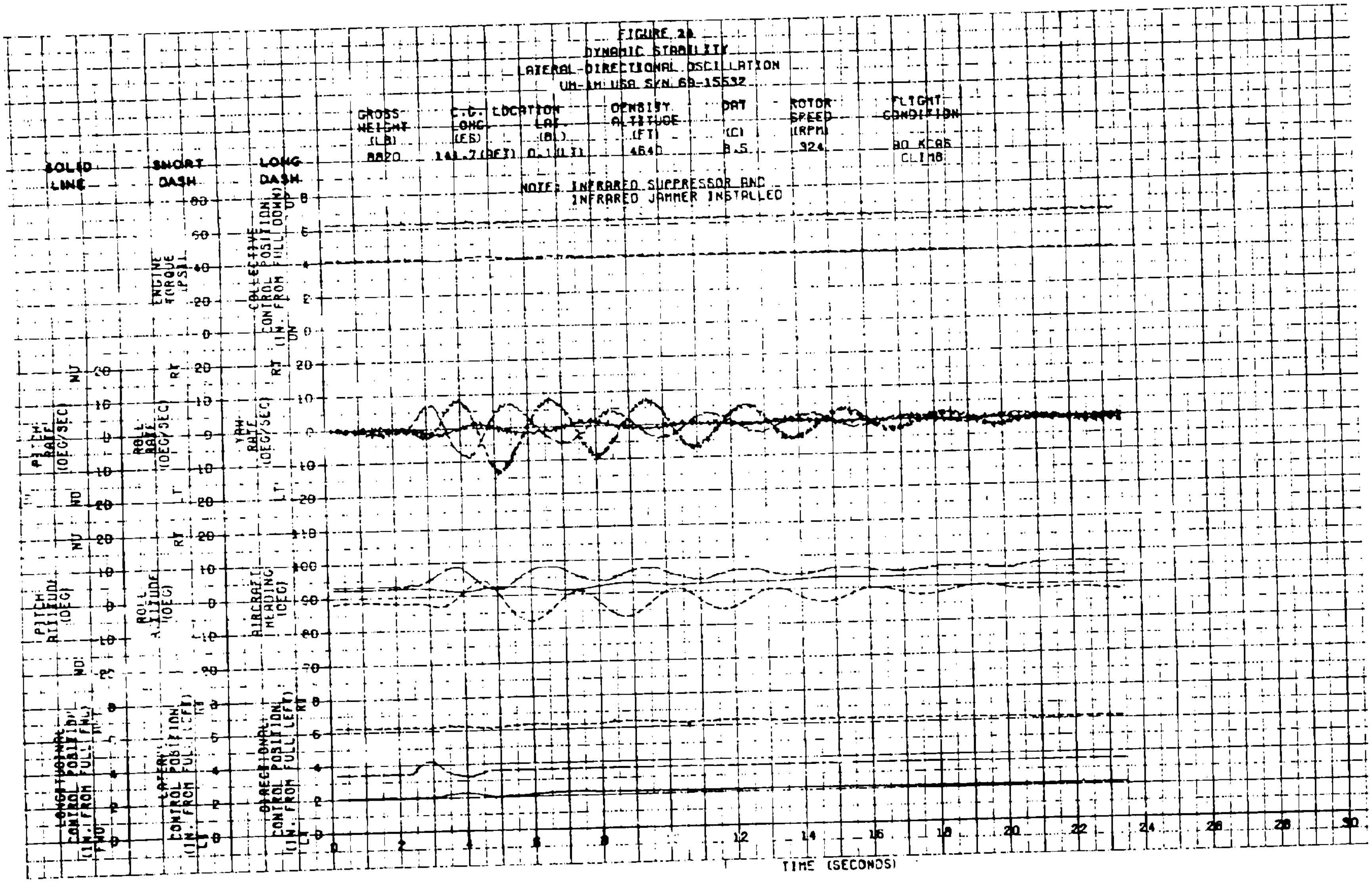


FIGURE 28
DYNAMIC STABILITY
LATERAL-DIRECTIONAL OSCILLATION
UH-1H USA S/N 69-15532
GROSS WEIGHT (LB) 8820
C.G. LOCATION LONG (FS) 141.7(AFT)
C.G. LOCATION LAT (BL) 0.1(LT)
DENSITY ALTITUDE (FT) 4640
OAT (C) 8.5
ROTOR SPEED (RPM) 324
FLIGHT CONDITION 80 KCAS CLIMB
NOTE: INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED
SOLID LINE
SHORT DASH
LONG DASH
PITCH RATE (DEG/SEC)
ROLL RATE (DEG/SEC)
YAW RATE (DEG/SEC)
ENGINE TORQUE (PSI)
COLLECTIVE CONTROL POSITION (IN. FROM FULL DOWN)
PITCH ATTITUDE (DEG)
ROLL ATTITUDE (DEG)
AIRCRAFT HEADING (DEG)
LONGITUDINAL CONTROL POSITION (IN. FROM FULL FWD)
LATERAL CONTROL POSITION (IN. FROM FULL LEFT)
DIRECTIONAL CONTROL POSITION (IN. FROM FULL LEFT)
NU
ND
RT
LT
UP
DN
AFT
FWD
TIME (SECONDS)

FIGURE 27
DYNAMIC STABILITY
LATERAL-DIRECTIONAL OSCILLATION
UH-1H USA S/N 68-15592

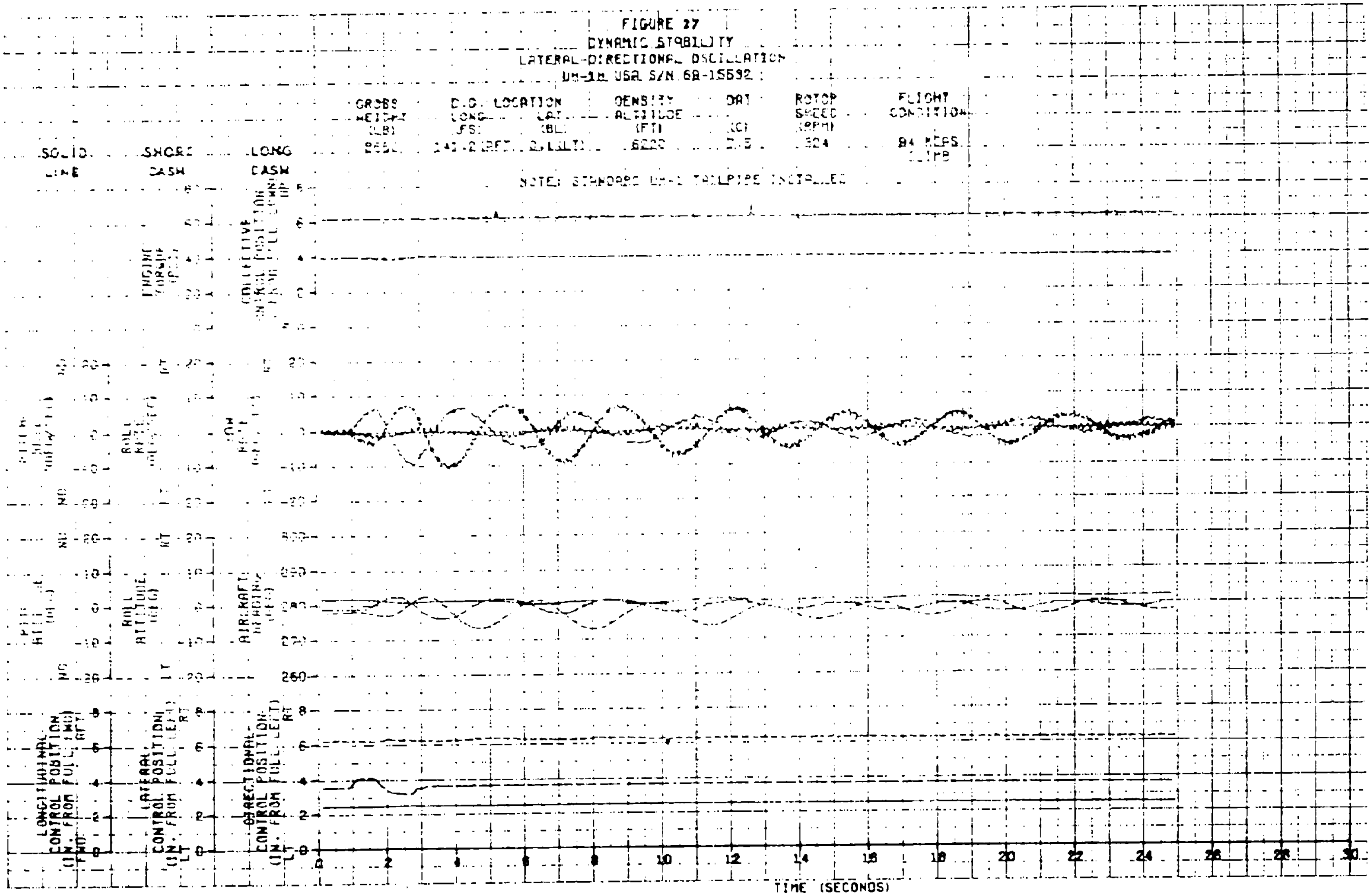


FIGURE 28
DYNAMIC STABILITY
LATERAL-DIRECTIONAL OSCILLATION
UH-1H USA S/N 68-15532

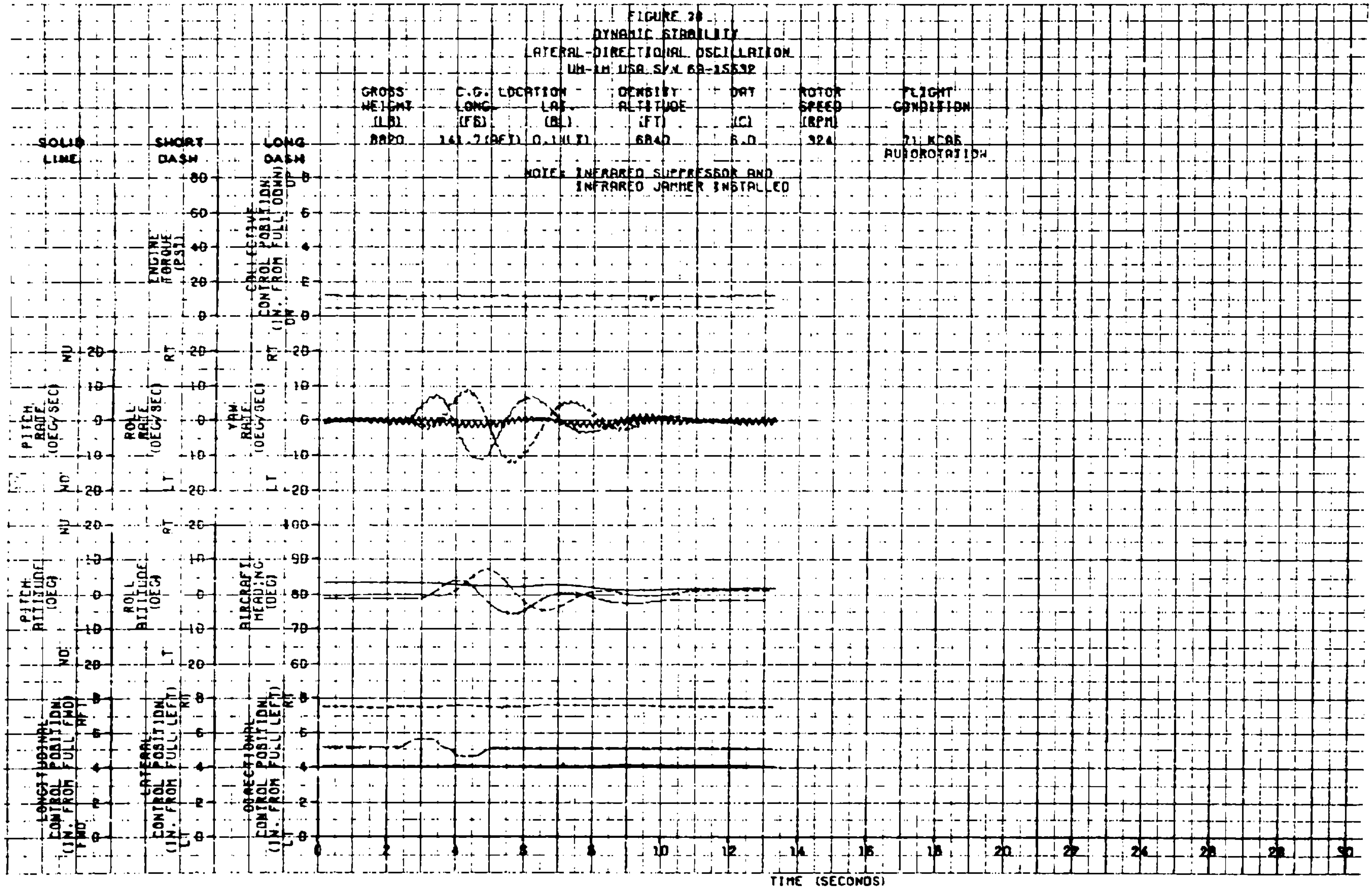


FIGURE 29
LOW SPEED FORWARD AND REARWARD FLIGHT
UH-1H USA S/N 69-15532

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)
8660	132.1 (FWD)	0.0 (MID)	1020	19.0	324

NOTES: 1. INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED.
2. I DENOTES MAXIMUM CONTROL EXCURSIONS.
3. SKID HEIGHT 10 FT.

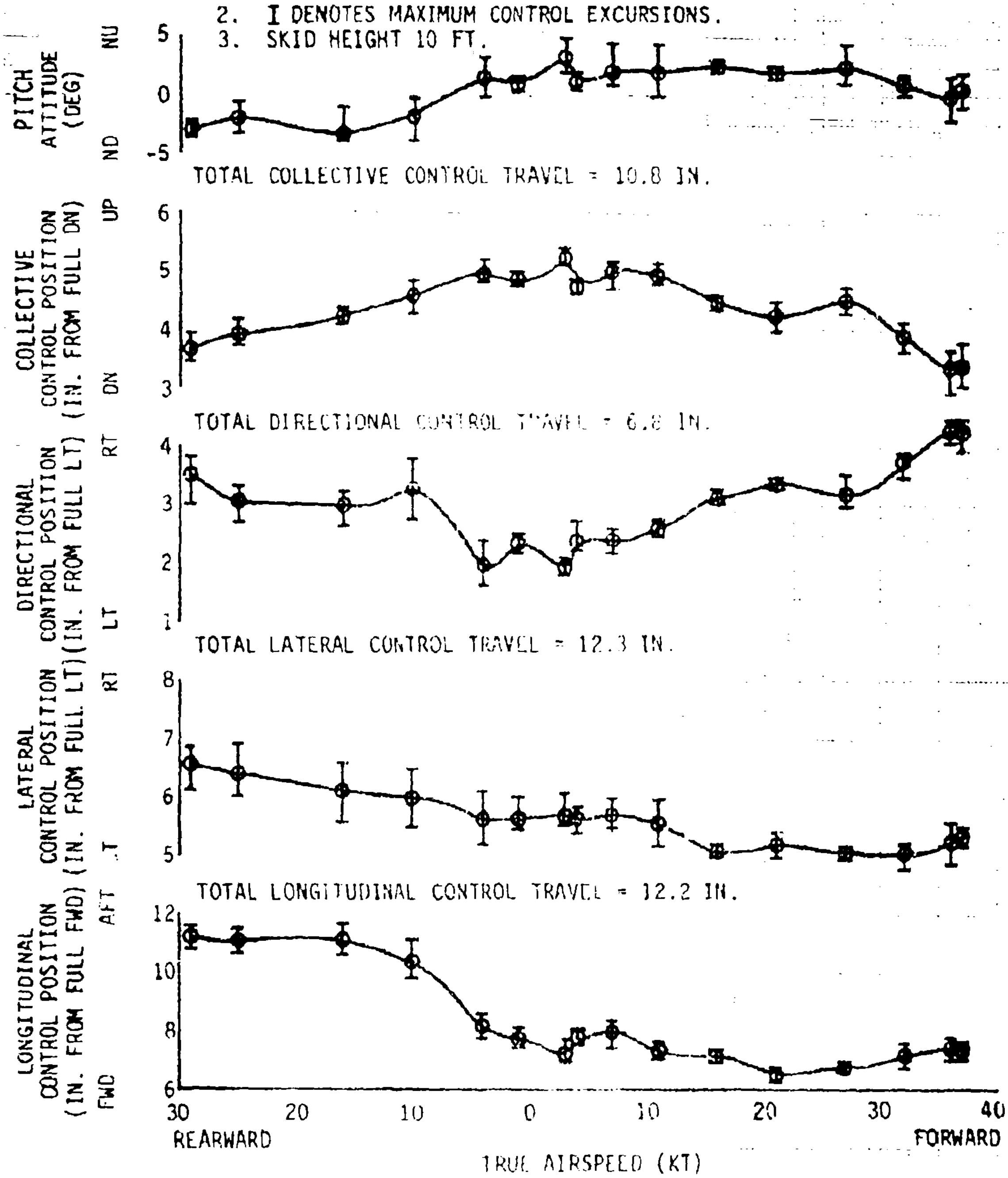


FIGURE 30
LOW SPEED FORWARD AND REARWARD FLIGHT
UH-1H USA S/N 69-15532

AVG GROSS WEIGHT (LB)	AVG CG LOCATION LONG (FS)	AVG CG LOCATION LAT (BL)	AVG DENSITY ALTITUDE (FT)	AVG OAT (°C)	AVG ROTOR SPEED (RPM)
8860	141.9(AFT)	0.1(LT)	2540	16.0	324

NOTES: 1. INFRARED SUPPRESSSOR AND INFRARED JAMMER INSTALLED.
2. I DENOTES MAXIMUM CONTROL EXCURSIONS.
3. SKID HEIGHT 10 FT.

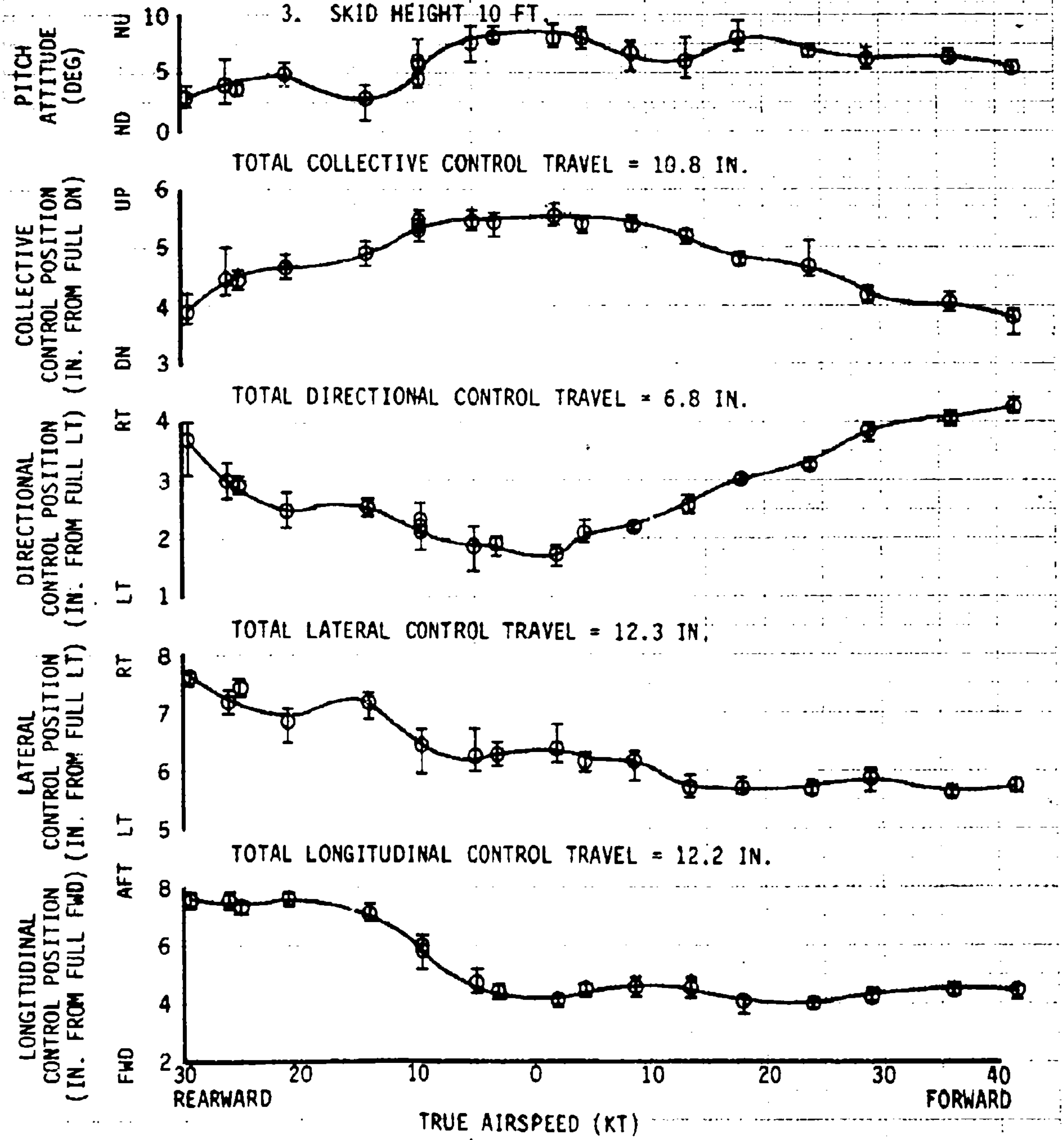


FIGURE 31
SIDEWARD FLIGHT
UH-1H USA S/N 69-15532

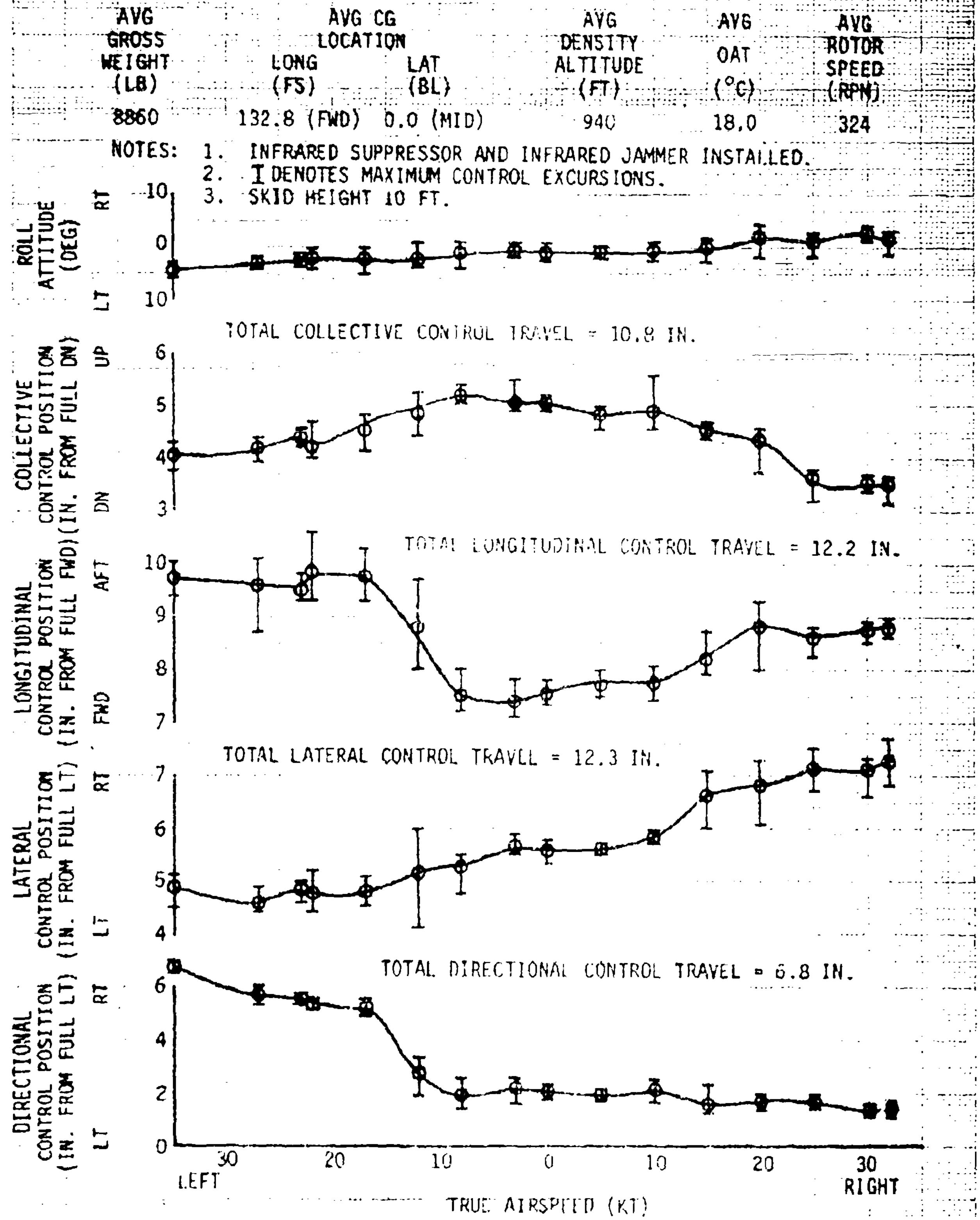


FIGURE 32
SIDEWARD FLIGHT
UH-1H USA S/N 69-16532

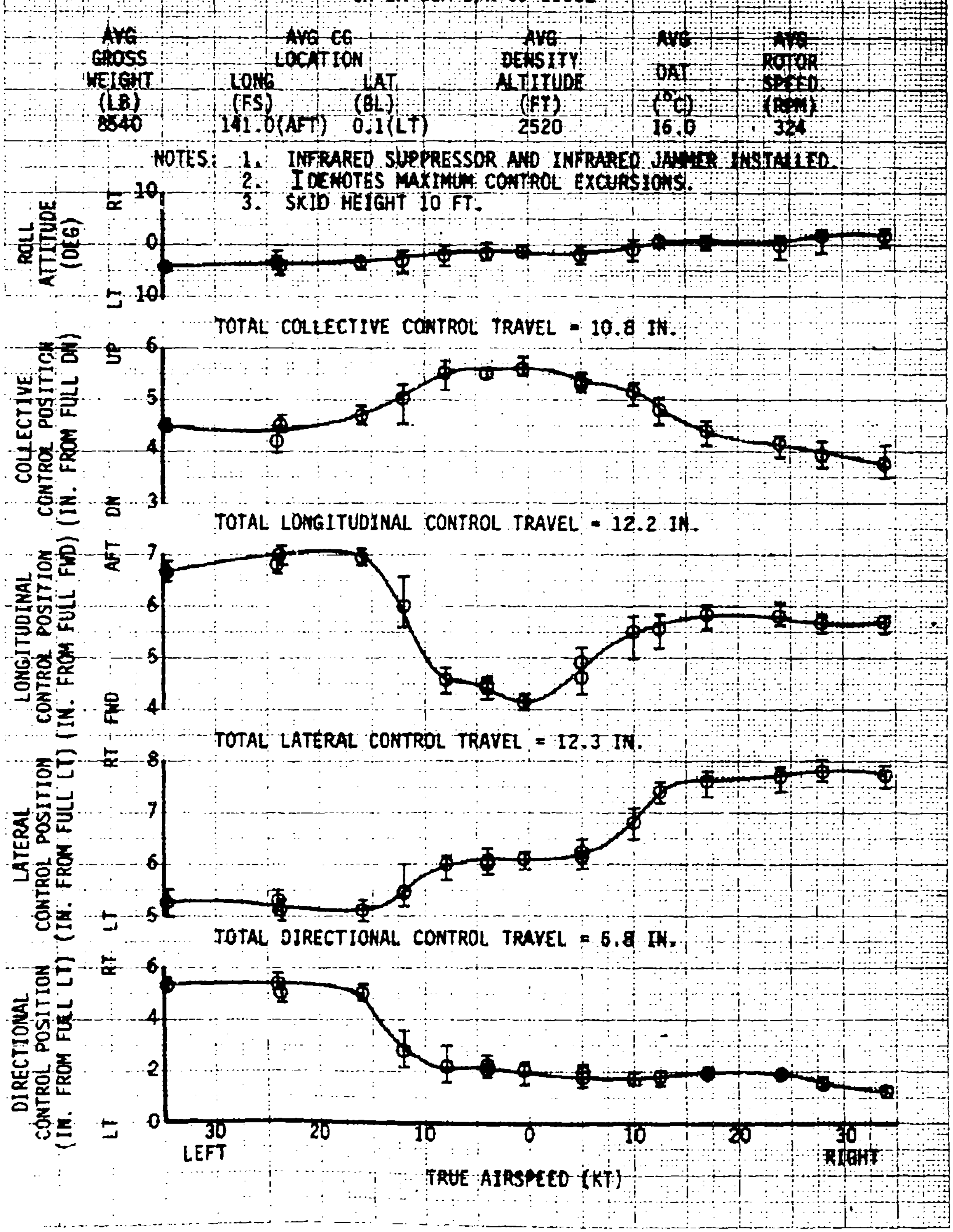
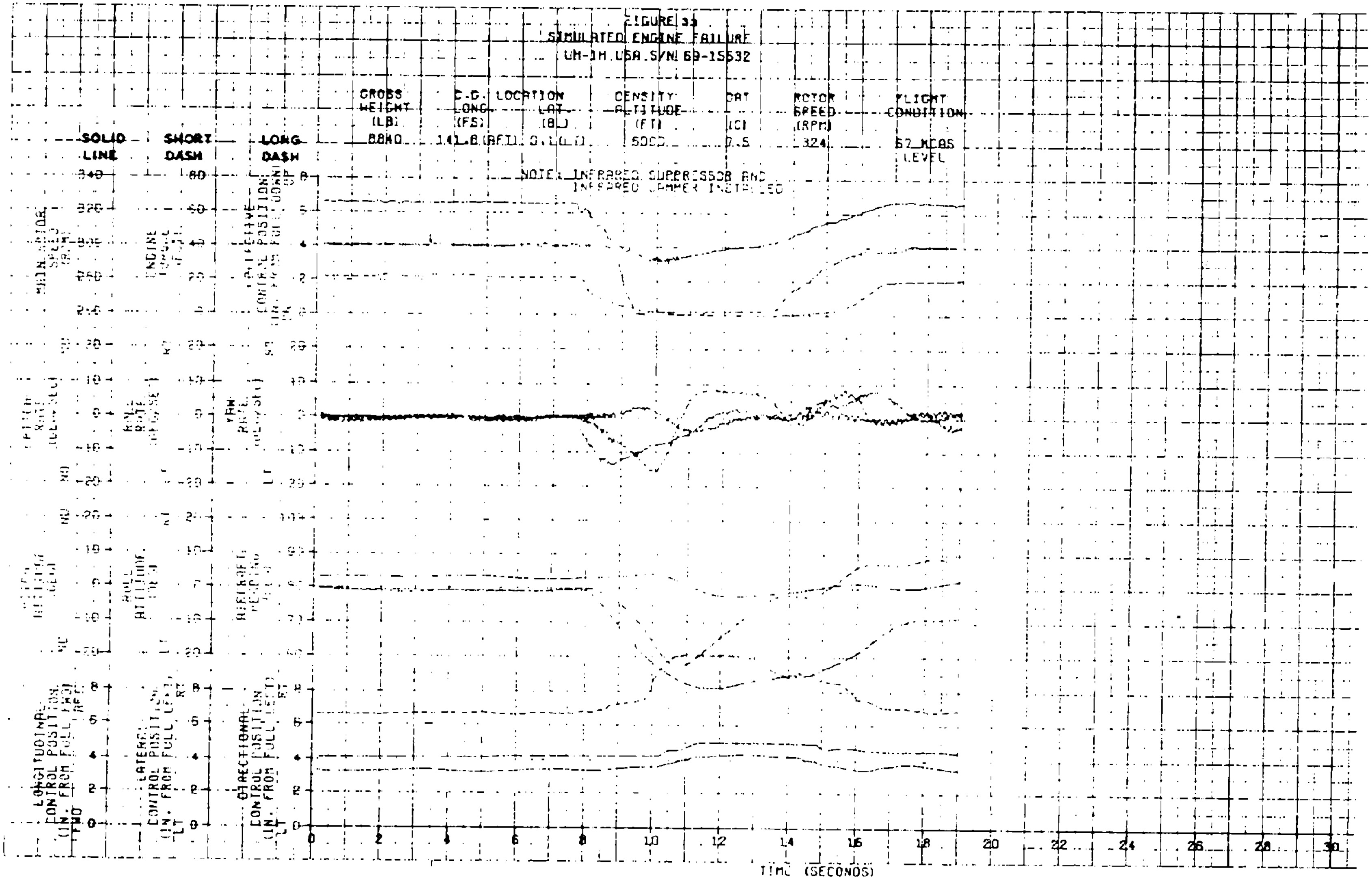


FIGURE 33
SIMULATED ENGINE FAILURE
UH-1H USA S/N 69-15532



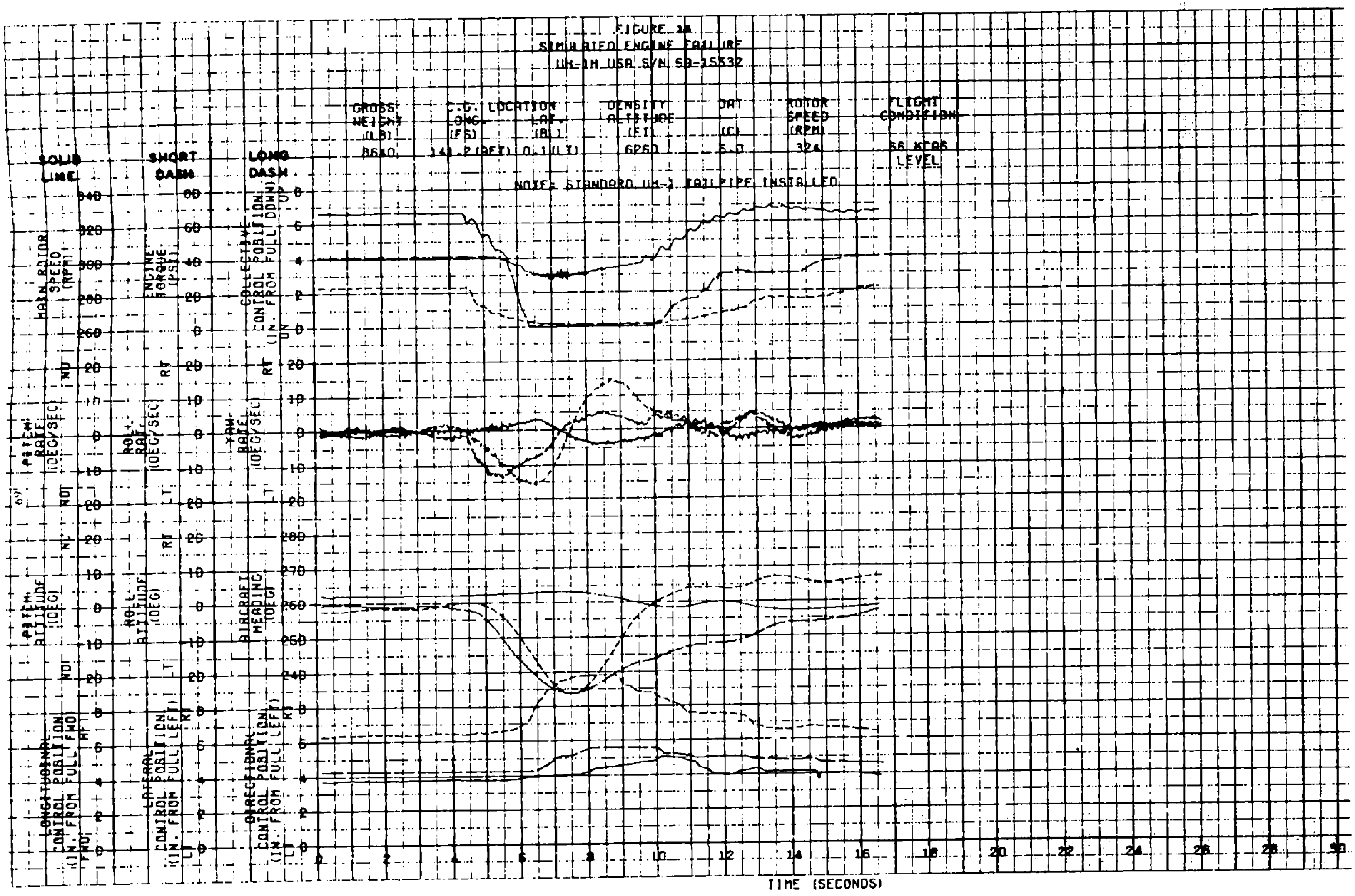


FIGURE 18
SIMULATED ENGINE FAILURE
UH-1H USA S/N 59-15532
GROSS WEIGHT (LB) 8640
C.G. LOCATION LONG. (FS) 141.2 (AFT)
LAT. (BL) 0.1 (LT)
DENSITY ALTITUDE (FT) 6260
OAT (C) 5.0
ROTOR SPEED (RPM) 324
FLIGHT CONDITION 56 KTAS LEVEL
NOTE: STANDARD UH-1 TAILPIPE INSTALLED
SOLID LINE
SHORT DASH
LONG DASH
MAIN ROTOR SPEED (RPM)
ENGINE TORQUE (PSI)
COLLECTIVE CONTROL POSITION (IN. FROM FULL DOWN)
PITCH RATE (DEG/SEC)
ROLL RATE (DEG/SEC)
YAW RATE (DEG/SEC)
PITCH ATTITUDE (DEG)
ROLL ATTITUDE (DEG)
AIRCRAFT HEADING (DEG)
LONGITUDINAL CONTROL POSITION (IN. FROM FULL FWD)
LATERAL CONTROL POSITION (IN. FROM FULL LEFT)
DIRECTIONAL CONTROL POSITION (IN. FROM FULL LEFT)
TIME (SECONDS)

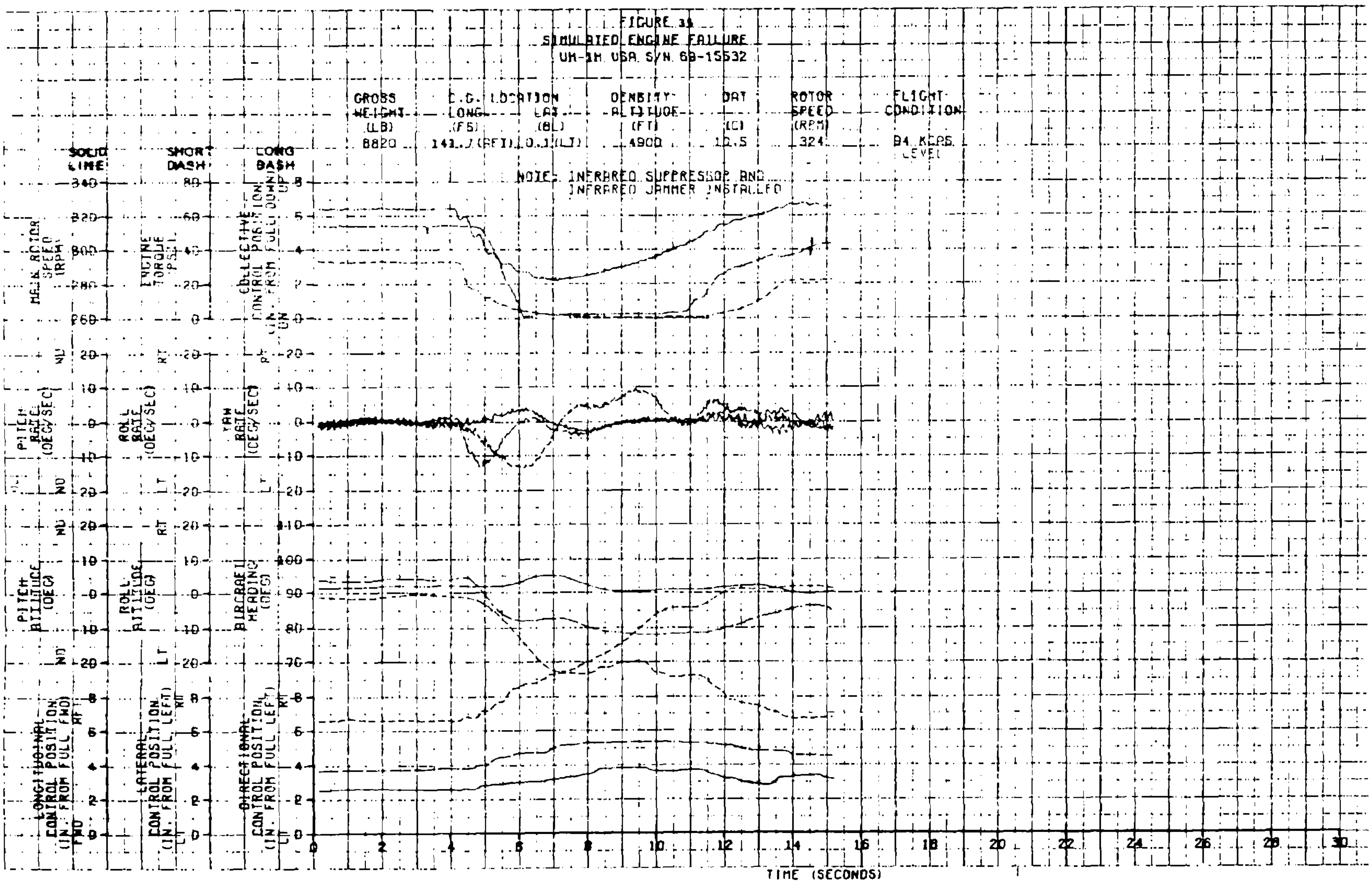


FIGURE 31
SIMULATED ENGINE FAILURE
UH-1H USA S/N 69-15532
GROSS WEIGHT (LB) 8820
C.G. LOCATION LONG (FS) 141.7(RFT) LAT (BL) 0.1(LT)
DENSITY ALTITUDE (FT) 4900
OAT (C) 10.5
ROTOR SPEED (RPM) 324
FLIGHT CONDITION 84 KCAS LEVEL
NOTE: INFRARED SUPPRESSOR AND INFRARED JAMMER INSTALLED
SOLID LINE
SHORT DASH
LONG DASH
MAIN ROTOR SPEED (RPM)
ENGINE TORQUE (PSI)
COLLECTIVE CONTROL POSITION (IN. FROM FULL DOWN)
PITCH RATE (DEG/SEC)
ROLL RATE (DEG/SEC)
YAW RATE (DEG/SEC)
PITCH ATTITUDE (DEG)
ROLL ATTITUDE (DEG)
AIRCRAFT HEADING (DEG)
LONGITUDINAL CONTROL POSITION (IN. FROM FULL FWD)
LATERAL CONTROL POSITION (IN. FROM FULL LEFT)
DIRECTIONAL CONTROL POSITION (IN. FROM FULL LEFT)
TIME (SECONDS)

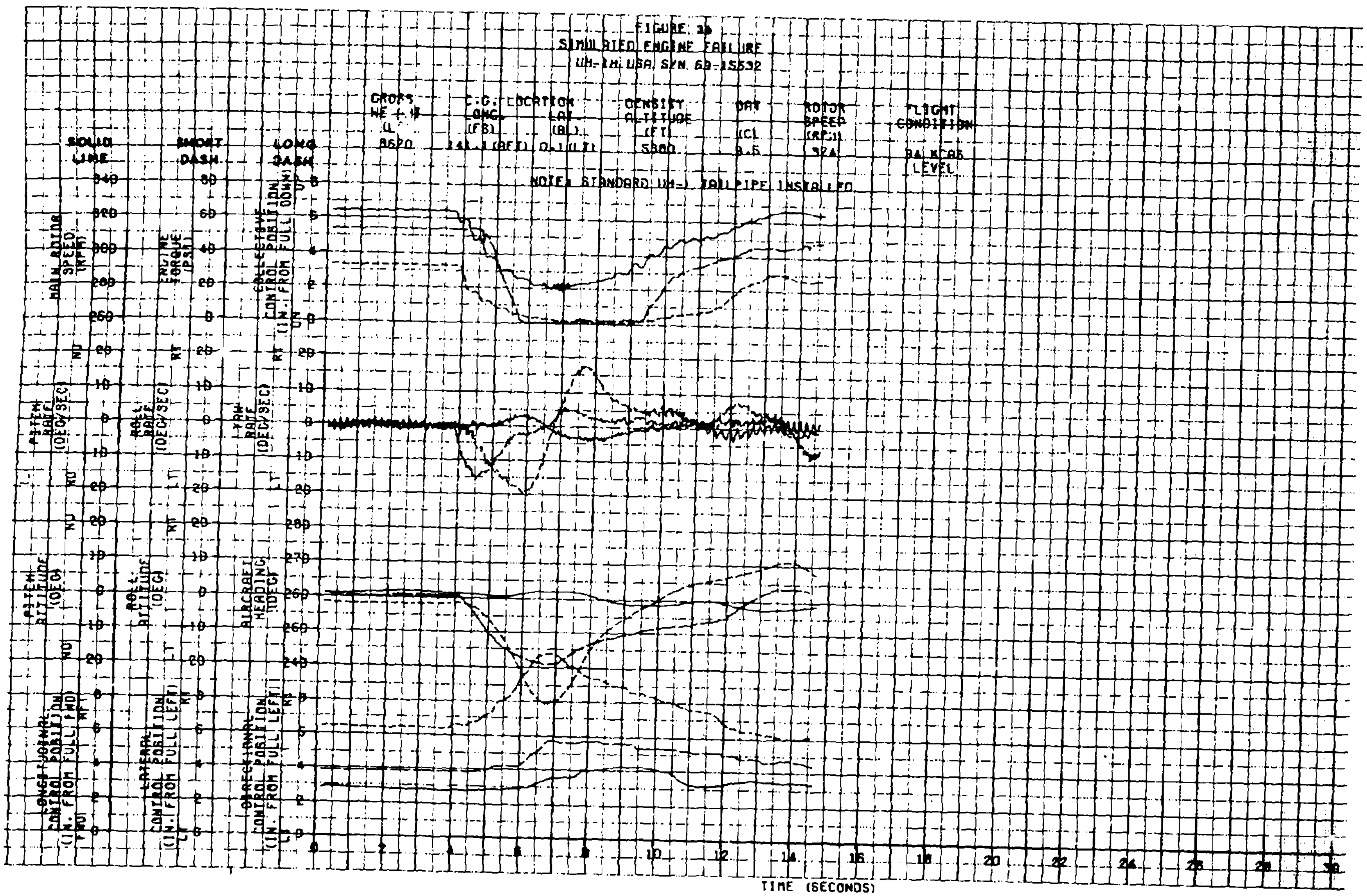


FIGURE 36
SIMULATED ENGINE FAILURE
UH-1H USA S/N 69-15532
GROSS WEIGHT (LB) 8620
C.G. LOCATION LONG (FS) 141.1 (AFT) LAT (BL) 0.1 (LT)
DENSITY ALTITUDE (FT) 5800
OAT (C) 9.5
ROTOR SPEED (RPM) 324
FLIGHT CONDITION 94 KCAS LEVEL
NOTE: STANDARD UH-1 TAILPIPE INSTALLED
SOLID LINE
SHORT DASH
LONG DASH
MAIN ROTOR SPEED (RPM)
ENGINE TORQUE (PSI)
COLLECTIVE CONTROL POSITION (IN. FROM FULL DOWN)
PITCH RATE (DEG/SEC)
ROLL RATE (DEG/SEC)
YAW RATE (DEG/SEC)
PITCH ATTITUDE (DEG)
ROLL ATTITUDE (DEG)
AIRCRAFT HEADING (DEG)
LONGITUDINAL CONTROL POSITION (IN. FROM FULL FWD)
LATERAL CONTROL POSITION (IN. FROM FULL LEFT)
DIRECTIONAL CONTROL POSITION (IN. FROM FULL LEFT)
TIME (SECONDS)

Table 1. IR Suppressor Pressure Survey

Sensor[1] Number	Description	Climb[2]	Level			Sideslips 90 KIAS						Autorotation
		70 KIAS	60 KIAS	80 KIAS	100 KIAS	10° LT	20° LT	27° LT	10° RT	20° RT	27° RT	70 KIAS
1	Static[3] Pressure	-.095	-.010	-.003	.017	-.018	-.017	-.048	.005	.100	.080	.110
2		-.130	-.055	-.030	-.028	-.053	-.078	-.103	-.060	-.007	.015	.105
3		-.150	-.075	-.057	-.023	-.038	-.022	.043	.005	0	.028	.110
4		-.055	.005	.037	.037	.007	.013	.022	.070	.110	.109	.110
5	Static Pressure	.005	.060	.077	.097	.032	.048	.022	.150	.240	.230	.130
6		-.015	.030	.062	.082	.051	.093	.072	.130	.173	.180	.125
7		-.025	.037	.052	.072	.017	.108	.107	.083	.135	.135	.125
8		-.035	.022	.032	.047	.052	.093	.037	.110	.130	.145	.140
9	Total Pressure	-.050	.032	.057	.092	.039	.063	.022	.090	.285	.285	.105
10		-.010	.042	.057	.084	.067	.098	.047	.120	.195	.200	.130
11		-.025	.035	.052	.080	-.103	.093	.123	.100	.115	.095	.130
12		-.090	.018	-.015	0	-.048	.088	.022	.105	.165	.167	.115
13	Total Pressure	.020	-.032	.052	.077	.027	.008	-.008	.070	.050	.060	.130
14		-.065	-.003	0	.037	.057	.078	.067	.080	.140	.150	.130
15		-.010	-.032	.052	.082	.022	-.027	-.063	.070	.070	.065	.120
16		-.055	.022	.007	.017	-.033	-.127	-.178	-.022	-.045	.075	.100
17	Total Pressure	.010	.037	.077	.114	.032	.008	0	.035	.160	.165	.115
18		-.035	.042	.062	.102	.027	0	-.023	.075	.070	.100	.120
19		-.035	.027	.052	.082	-.028	-.049	-.028	.090	.065	.070	.120
20		-.065	.022	.007	.035	.023	-.177	-.193	-.020	-.020	.050	.110
	Pressure Altitude	3900	4300	4300	4100	5100	4800	4400	5200	5000	4700	4200

NOTES:

[1] Sensor numbers correspond to location shown in appendix C.
[2] Indicated engine torque 40 psi.
[3] Pressure measured in psi differential referred to boom indicated static pressure.

Table 2. IR Suppressor Pressure Survey

Sensor[1] Number	Description	Forward				Left Sideward			Right Sideward			Rearward				Hover	
		10 KTAS	20 KTAS	30 KTAS	40 KTAS	10 KTAS	20 KTAS	30 KTAS	10 KTAS	20 KTAS	30 KTAS	5 KTAS	10 KTAS	20 KTAS	30 KTAS	IGE	OGE
1	Static[2] Pressure	-.048	-.045	-.045	-.040	-.110	-.090	-.060	-.070	-.075	-.055	-.112	-.072	-.068	-.062	-.118	-.110
2		-.103	-.095	-.080	-.075	-.090	-.090	-.120	-.100	-.115	-.095	-.126	-.095	-.092	-.105	-.123	-.135
3		-.143	-.130	-.115	-.105	-.090	-.100	-.125	-.110	-.150	-.070	-.149	-.117	-.102	-.090	-.113	-.130
4		-.033	-.020	-.015	-.020	-.030	-.025	-.040	-.035	-.045	-.035	-.064	.045	-.042	-.040	-.030	-.045
5	Static Pressure	-.005	0	.010	.015	-.005	-.010	-.015	-.015	-.015	-.015	-.019	-.025	-.018	-.018	.005	-.017
6		0	0	0	.005	-.015	-.020	-.015	-.015	-.010	-.010	-.022	-.020	-.016	-.017	-.010	-.025
7		-.010	0	.005	0	-.025	-.020	-.010	-.030	-.020	-.010	-.015	-.010	-.022	-.024	-.008	-.020
8		-.008	-.005	.005	-.005	-.025	-.020	-.005	-.010	-.035	-.010	-.027	-.022	-.007	.004	0	-.015
9	Total Pressure	.015	.010	.005	.020	-.005	.010	.010	-.010	0	.005	.003	-.002	-.032	-.005	.005	.009
10		.009	.005	0	.010	-.010	-.020	-.005	-.015	-.010	-.015	.008	-.010	-.009	-.017	-.018	0
11		-.003	0	0	.010	.005	-.005	0	-.010	-.020	-.015	.002	.003	-.009	-.006	-.013	.010
12		.014	.005	0	-.010	-.010	-.010	-.005	.010	-.005	0	-.016	-.012	.002	.009	.006	-.019
13	Total Pressure	.005	.005	.005	.005	.015	0	.025	.025	.035	.035	.011	.017	.025	.027	.010	.005
14		-.010	-.005	0	0	-.020	-.020	-.010	-.025	-.020	-.015	-.022	-.020	-.027	-.020	-.008	-.017
15		.011	.010	.010	.010	.045	.010	.015	.025	.010	.005	.005	.007	.021	.020	.015	0
16		.008	.008	.005	.005	-.110	-.125	-.015	.030	-.025	-.035	0	.035	.027	.020	.015	.030
17	Total Pressure	.020	.020	.015	.015	.010	0	.015	.020	-.025	.030	-.057	-.075	.025	.020	.020	-.080
18		.007	.009	.010	.010	-.100	-.050	-.020	.020	.010	-.050	-.012	-.040	.023	.020	.013	.015
19		.005	.007	.010	.010	.030	.040	0	-.005	.005	0	-.032	-.015	.018	.017	.017	-.065
20		.009	.010	.010	.005	-.100	-.085	.035	.025	.005	-.025	-.038	.016	.017	.010	.023	.033
	Pressure Altitude	500	500	500	500	500	500	500	500	500	500	500	500	500	500	550	650

NOTES:

[1] Sensor numbers correspond to location shown in appendix C.
[2] Pressure measured in psi differential referred to boom indicated static pressure.

TABLE 3

IR SUPPRESSOR AND TAILBOOM TEMPERATURE SURVEY

Thermocouple Number	Climb 70 KIAS	LEVEL 60 KIAS	LEVEL 80 KIAS	LEVEL 100 KIAS	SIDESLIPS 90 KIAS 10 RT	20 RT	[illegible] RT	10 LT	20 LT	[illegible] LT	IGE HOVER[4] [illegible]	[illegible]	90	135	180	225	270	315	Temperature Tape Number	Level Flight and Sideslips[5]	IGE and OGE Hover[5]	Light Gross Weight Mission Maneuvers[3]
1	39	38	41	43	40	42	33	37	[illegible]	45	37	[illegible]	[illegible]	34	35	37	40	43	25	61	48	
2	[illegible]	30	31	32	29	34	34	29	29	30	43	[illegible]	26	28	25	25	28	41	26		43	
3	24	24	24	25	23	25	21	[illegible]	28	28	[illegible]	[illegible]	21	[illegible]	20	22	26	26	27		48	
4	21	[illegible]	27	28	23	24	25	24	22	22	[illegible]	[illegible]	22	[illegible]	20	21	22	24	28			
5	19	23	21	22	21	21	21	24	23	23	[illegible]	[illegible]	22	[illegible]	20	22	22	23	29		43	
6	20	22	22	23	20	21	21	20	21	22	[illegible]	[illegible]	21	24	21	22	20	21	30			
7	22	23	23	24	21	24	25	21	21	23	31	21	21	20	17	21	20	20	31	43	42	
8	[illegible]	[illegible]	[illegible]	23	23	22	22	23	23	23	[illegible]	[illegible]	23	21	22	24	25	23	32	61	61	
9	21	21	23	[illegible]	22	22	21	23	23	23	[illegible]	21	21	19	19	21	[illegible]	21	33	66	66	
10	24	24	24	24	24	25	27	24	22	[illegible]	29	26	27	28	25	27	26	26	34	71	127	82
11	21	21	22	24	22	24	27	24	23	24	[illegible]	28	32	31	36	33	34	[illegible]	35	109	160	127
12	24	23	22	23	23	24	22	23	26	24	32	31	30	43	29	32	44	38	36	117	138	120
13	21	22	23	24	24	23	26	23	23	25	33	30	38	56	37	73	66	38	37	120	120	109
14	23	23	23	24	23	24	23	26	27	27	58	43	61	101	53	72	84	36	38		[illegible]	82
15	22	24	24	25	27	24	27	23	24	26	[illegible]	66	107	120	114	121	85	88	39	82	92	43
16	26	28	27	27	24	24	22	30	28	28	53	64	127	122	121	138	116	75	40	82	104	61
17	31	30	27	27	34	25	26	24	23	24	110	112	97	68	99	83	75	107	41	82	117	88
18	58	53	45	41	26	24	22	45	28	34	128	130	98	69	100	89	57	128	42	82	[illegible]	82
19	62	47	46	33	56	52	26	25	23	25	57	91	50	36	60	38	43	81	43	66	88	66
20	51	76	63	55	39	24	23	38	27	33	96	96	51	35	64	41	51	93	44	54	80	54
21	79	48	43	38	71	38	27	25	23	25	57	64	38	32	39	29	32	56	45	54	[illegible]	54
22	31	68	65	58	45	26	23	40	27	34	66	68	35	29	39	32	39	64	AMB	24	24	16
23	26	[illegible]	23	24	[illegible]	22	24	22	23	23	61	75	58	37	32	36	38	61				
24	30	22	22	23	34	22	22	27	24	24	104	92	46	37	78	56	67	104				
AMB	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24				

NOTES:

[1] Temperatures in degrees Celsius.
[2] Thermocouple and temperature tape numbers correspond to locations shown in Appendix C.
[3] Indicated Engine Torque 40psi.
[4] Winds 8 to 10 KTS, Azimuth reletive to nose of aircraft.
[5] Temperature sensitive tapes were graduated in 10°F increments.
Temperatures presented are the highest indicated by the tape, converted to degrees Celsius.

TABLE 4[1]

IR SUPPRESSOR AND TAILBOOM TEMPERATURE SURVEY

Thermocouple Number[2]	HOVER		FORWARD				REARWARD			LEFT			RIGHT			Temperature Tape Number[2,3]	Forward, Rearward, Left and Right
	OGE	IGE	10 KTAS	20 KTAS	30 KTAS	40 KTAS	10 KTAS	20 KTAS	30 KTAS	10 KTAS	20 KTAS	30 KTAS	10 KTAS	20 KTAS	30 KTAS		
1	37	39	34	31	33	33	36	40	33	36	34	36	36	26	30	25	49
2	23	34	29	30	26	26	25	39	39	22	29	28	33	32	31	26	43
3	22	27	22	23	21	21	21	22	33	23	21	20	23	21	21	27	49
4	20	28	22	21	21	20	22	24	26	18	23	22	22	25	25	28	
5	21	22	18	19	18	16	22	25	26	22	20	19	20	19	22	29	
6	21	21	17	18	17	18	23	27	24	17	18	22	21	19	20	30	
7	19	21	16	17	17	18	20	28	26	18	21	20	20	22	21	31	43
8	23	24	20	19	21	20	24	30	30	24	24	23	22	24	27	32	43
9	19	21	17	18	18	18	22	30	[illegible]	17	19	20	20	20	20	33	49
10	29	26	21	21	23	23	27	26	29	23	21	27	24	26	26	34	127
11	36	31	20	25	23	23	35	33	36	36	26	33	26	35	29	35	171
12	31	28	26	20	24	23	30	40	40	79	75	49	24	63	40	36	138
13	108	34	23	23	23	24	68	42	58	63	80	90	25	[illegible]	[illegible]	37	136
14	131	33	28	21	24	24	66	58	74	90	100	97	62	117	[illegible]	38	110
15	127	80	34	33	35	33	108	64	84	58	71	81	58	127	100	39	104
16	147	65	44	40	45	45	109	88	100	78	82	84	105	103	76	40	104
17	66	100	74	78	69	66	83	86	85	56	68	87	103	64	62	41	104
18	51	111	87	90	84	77	87	92	98	39	59	67	110	67	59	42	110
19	34	76	80	92	82	79	60	78	79	31	49	56	78	44	47	43	104
20	30	92	96	109	99	79	62	82	85	29	52	64	78	46	48	44	[illegible]
21	30	55	68	80	85	78	47	71	63	29	43	49	56	41	46	45	71
22	27	57	79	95	101	80	50	70	68	28	51	51	55	43	46	AMB	25
23	33	56	52	52	56	40	52	69	69	26	53	63	77	55	54		
24	38	97	93	91	69	42	60	63	64	45	42	67	67	33	41		
AMB	25	24	20	20	20	20	24	25	26	21	21	22	23	23	23		

NOTES

[1] Temperatures in degrees Celsius.
[2] Thermocouple and temperature tape numbers correspond to locations shown in Appendix C.
[3] Temperature sensitive tapes were graduated in 10°F increments.
Temperatures presented are the highest indicated by the tape, converted to degrees Celsius.

APPENDIX F. EQUIPMENT PERFORMANCE REPORTS

EQUIPMENT PERFORMANCE REPORT (DARCOM AVCR 700-38)	DATE: 8 June 1981
	OFFICE SYMBOL: DAVTE-TA

TO:	FROM:
Commander U.S. Army Aviation R&D 4300 Goodfellow Blvd. St. Louis, MO 63120	Commander U.A. Army Aviation Engineering Flight Activity ATTN: DAVTE-TA (STop 217) Edwards AFB, CA 93523

1. EPR NO.:	2. TECOM/AVSCOM PROJ NO.:	3. TEST TITLE
80-06-1	USAAEFA 80-05	Prelim Eval of UH-1H with HMPP IR Suppressor and IR Jammer

I MAJOR ITEM DATA

4. MODEL: JUH-1H	5. SERIAL NO: 69-15532
6. QUANTITY: one	7. LIFE PERIOD:
8. MFR:	9. USA NO.:

II PART DATA

10. NOMENCLATURE/DESCRIPTION: Exhaust Duct	
11. FSN:	12. MFR PART NO.: Bell p/n 205-068-217-1
13. DRAWING NO.:	14. MFR: Bell Helicopter Textrom
15. QUANTITY:	16. NEXT ASSEMBLY:
17. MAC FUNCTIONAL GRP:	18. PART TEST LIFE:

III INCIDENT DATA

19. DATE OF OCCURRENCE:	20. TYPE OF REPORT:	21. ACTION TAKEN:
22. MAINT SPT, ELM, CODE:	a. INCIDENT	a. REPLACED
	b. INFORMATION	b. REPAIRED

23. OBSERVED DURING	24. TEST ENVIRONMENT	25. INCIDENT CLASSIFICATION:	21. ACTION TAKEN (cont.)
X a. OPERATION	Suspect that damage occurred during sideward or rearward flight		c. ADJUSTED
b. MAINTENANCE		a. CRITICAL	d. DISCONNECTED
INSPECTION		X b. MAJOR	X e. REMOVED
d. OTHER		c. MINOR	f. NONE

IV INCIDENT DESCRIPTION

26. DESCRIBE INCIDENT FULLY (INCLUDE IMPACT OF INCIDENT ON MAC CODE IDENTIFIED IN BLOCK 22):

During removal of the IR suppressor (191430-4), it was noted that there was damage to the exhaust duct (19134-1-1) where the exhaust duct fits internally into the IR suppressor bellmouth. The exhaust duct is warped out of shape and has been contacting the leading edge of the IR suppressor struts inside the bellmouth. Score marks on the struts indicate that there has been ±½" lateral flexing or movement against the strut. Looking at the exhaust duct from the rear of the aircraft at the 1 to 2 o'clock position, approximately ½ inch of duct metal has been pushed forward and torn where the suppressor strut contacted the duct.

I suspect two possible causes: (1) The exhaust duct warped out of shape against the struts causing the score marks on the struts. (2) The IR suppressor may be positioned too close to the exhaust duct as a result of the new fairing and bulkhead rework. In particular it appears that the new gusset support (Bell p/n 205-038-216-121 and -122) may move the suppressor further forward against the duct.

Recommend that the suppressor be repositioned aft of its present location and that the outer ring of the exhaust duct be reinforced similar to the standard UH-1 exhaust duct to prevent warpage.

INCIDENT CLASSIFICATION IS SUBJECT TO RECLASSIFICATION

27. DEFECTIVE MATERIAL SENT TO:

28. NAME, TITLE & TEL EXT OF PREPARER:	29. FOR THE COMMANDER:
LORAN HAWORTH GA-4 AV350-4785	

DARCOM FORM 2134

Previous edition may be used until exhausted.

EQUIPMENT PERFORMANCE REPORT

DATE: 30 JUL 81

OFFICE SYMBOL: DAVTE-TA

TO:
Commander
US Army Aviation R&D Command
ATTN: DRDAV-D
4300 Goodfellow Blvd.
St. Louis, MO 63120

FROM:
Commander
U.S. Army Aviation Engr Flt Activity
ATTN: DAVTE-TA, Stop 217
Edwards AFB, CA 93523

EPR NO.	TEST PROJECT NO.	TEST TITLE
80-05-2	80-05	UH-1H IR Suppressor

I MAJOR ITEM DATA

MODEL	UH-1H	SERIAL NO.	69-15532
QUANTITY	1		
MFR	Bell Helicopter Textron		

II PART DATA

Garrett HMPP IR Suppressor

Serial No. 129-417

MFR: Garrett AiResearch

QUANTITY: One (1)

III INCIDENT DATA

13 APR-12 MAY 81

X OPERATION

Special Flight Operations

ACTION TAKEN
a. REPLACED
b. REPAIRED
c. ADJUSTED
d. DISCONNECTED
e. REMOVED
f. NONE

IV INCIDENT DESCRIPTION

The new IR suppressor assembly (serial No. 129-147) provided for Phase II of this program was observed to have developed four burned areas (hot spots) as indicated by discoloration at the 10, 12, 2, and 4 o'clock positions around the suppressor surface aft of the mounting points. These "hot spots" appeared as shown in the accompanying photographs. Further investigation of the conditions creating the burned areas is warranted.

AV 850-4

DARCOM

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